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METAL INDUSTRY

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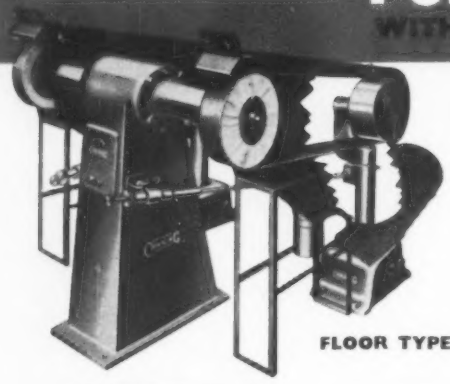

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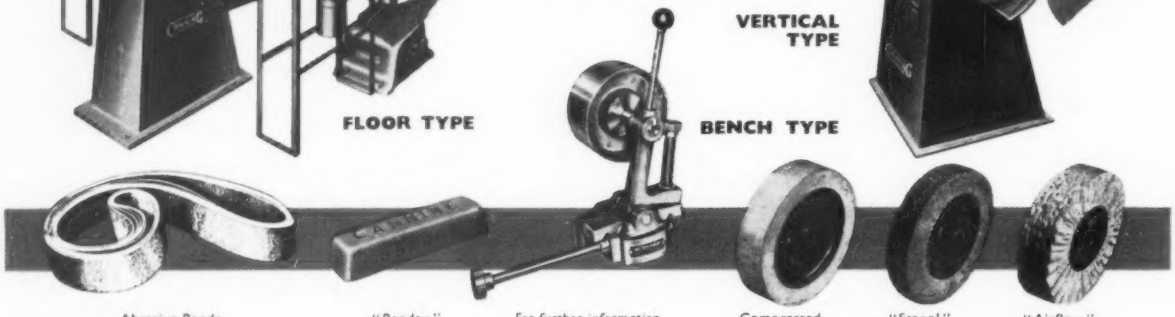

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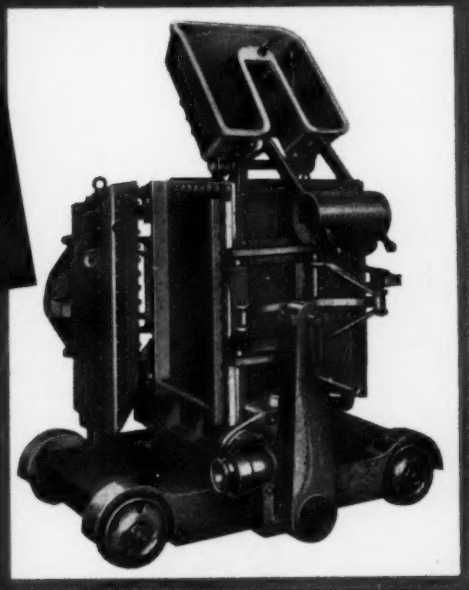

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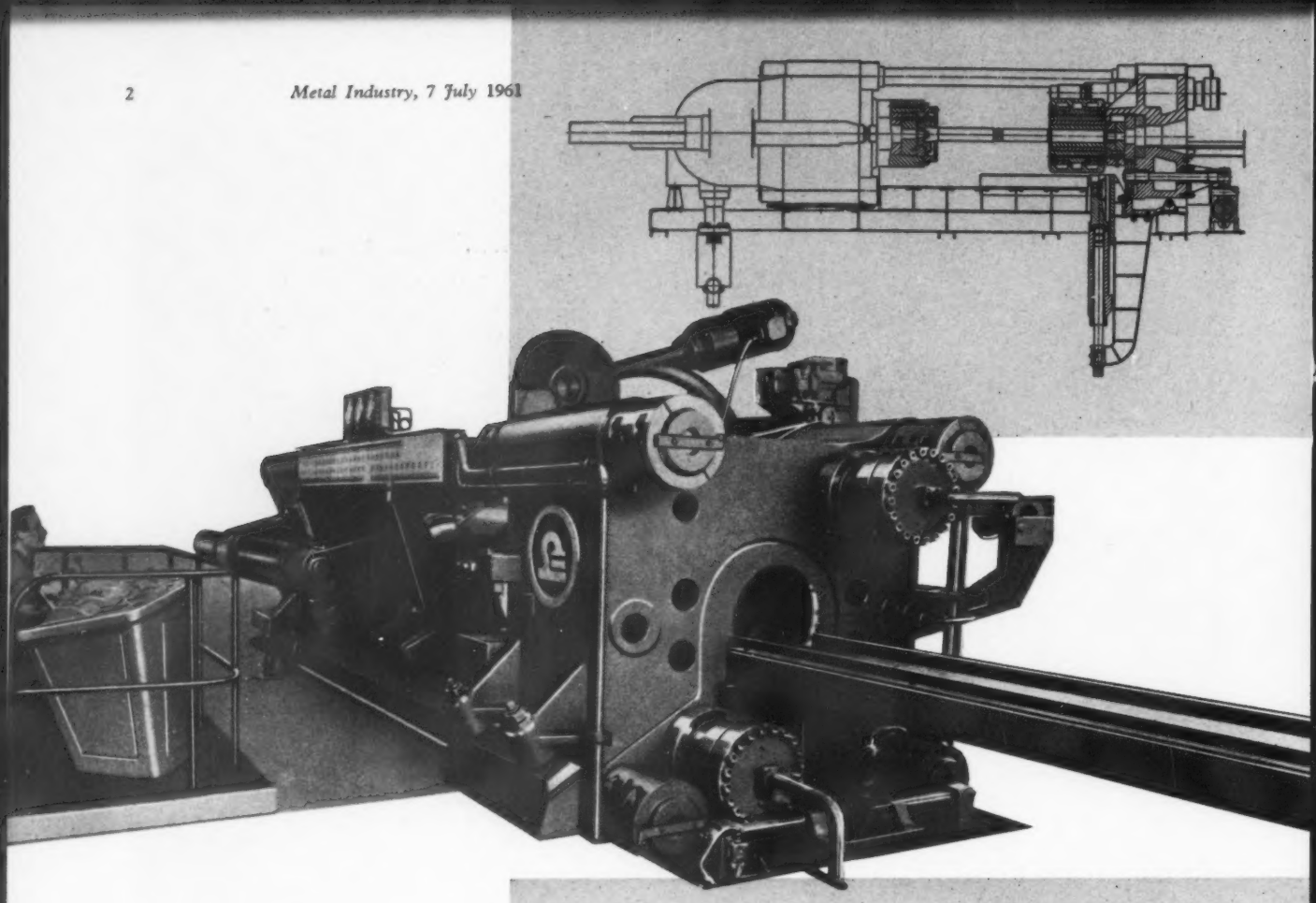

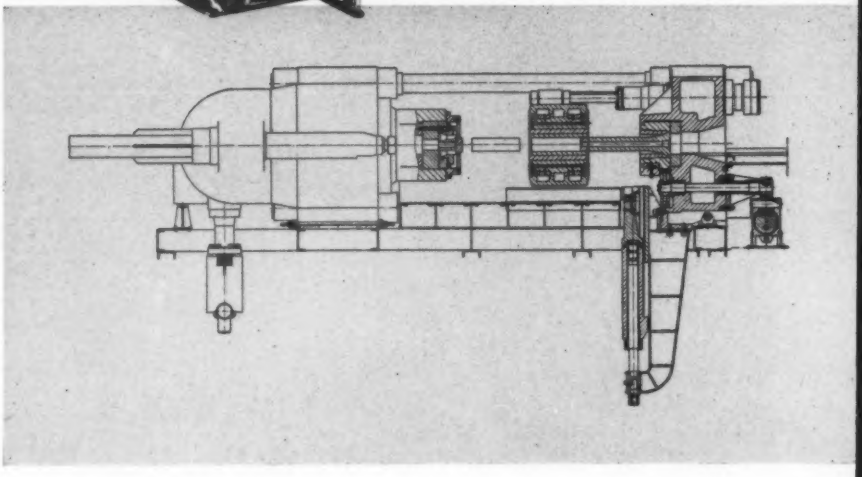

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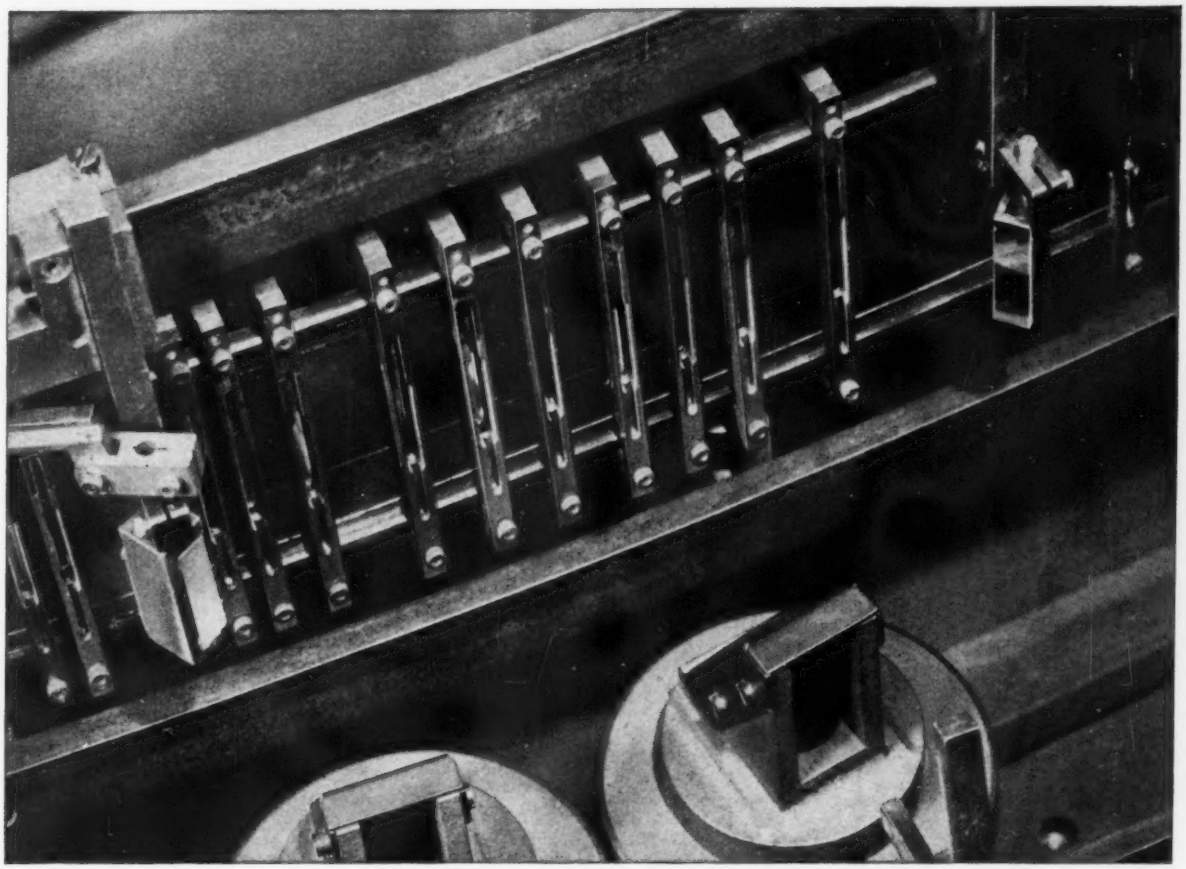

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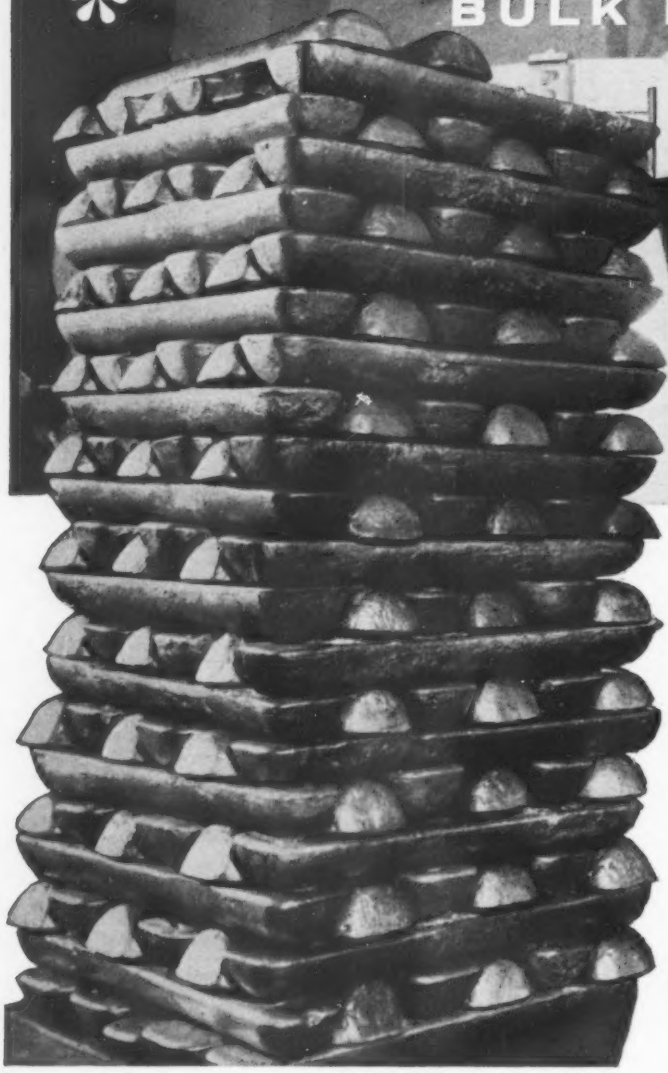

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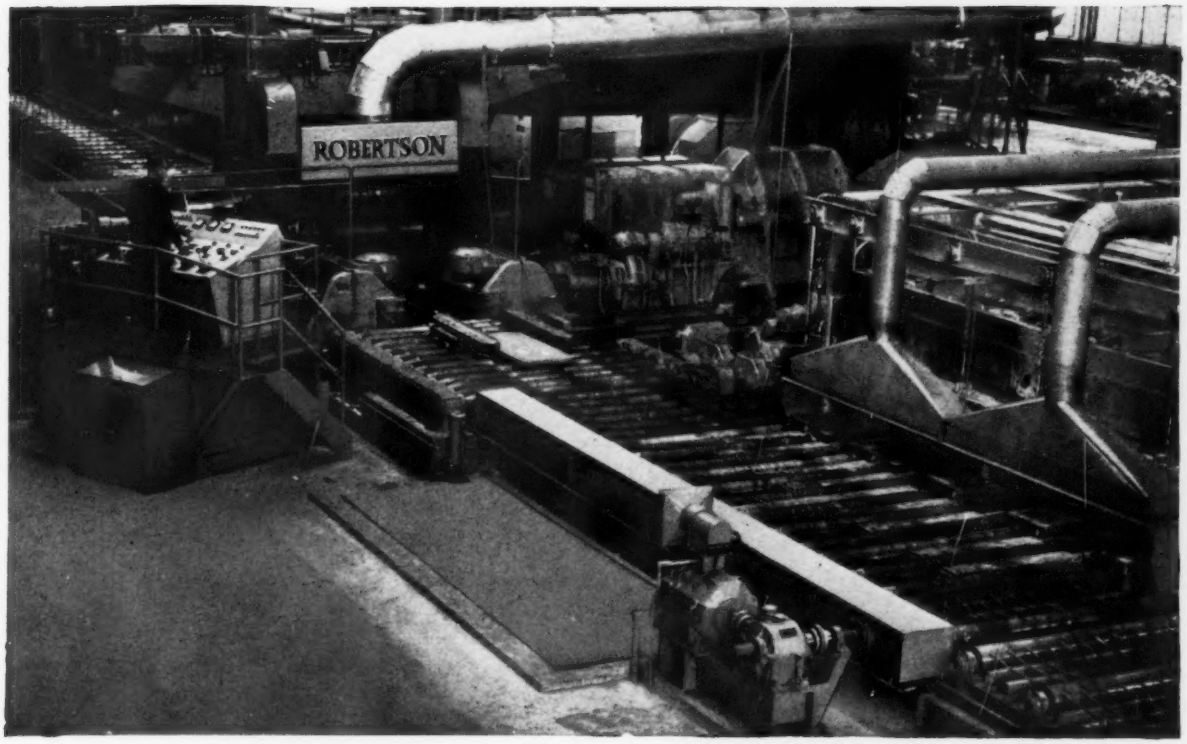

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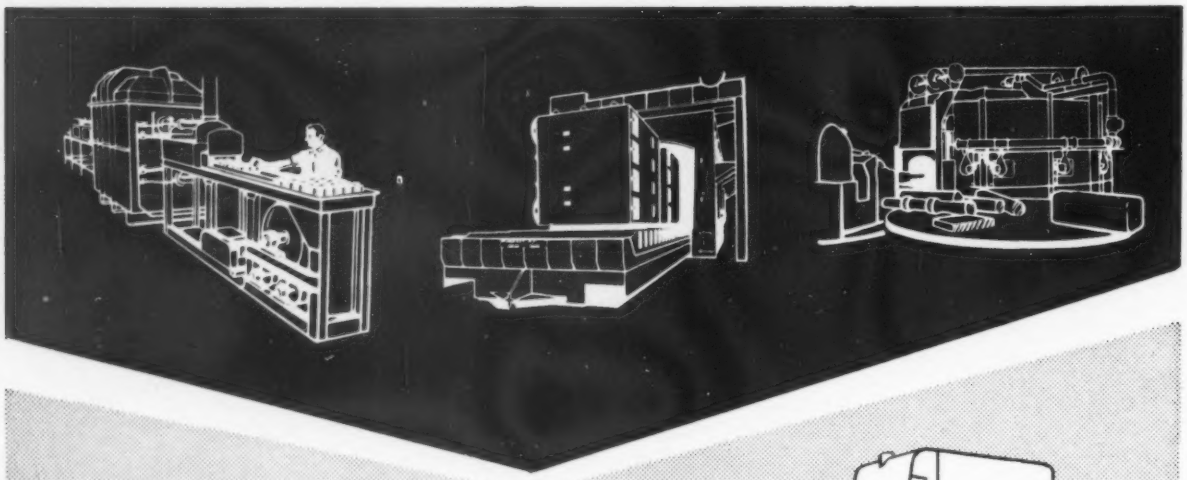
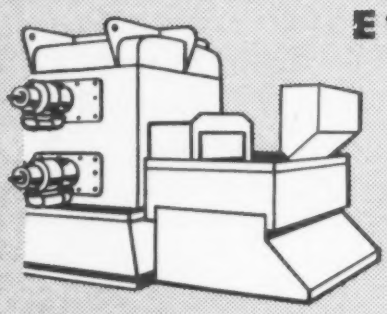
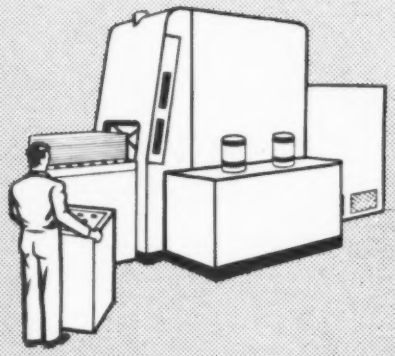
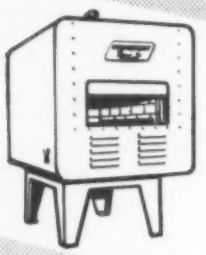


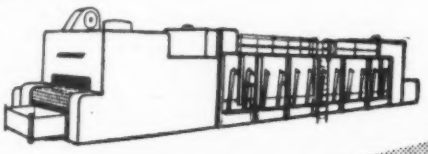


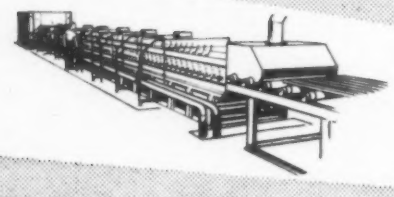
Every furnace you can think of!





from pins to ingots—to treat a handful or a cartload, whether a quick heat or a long soak, with a protective atmosphere or without—Incandescent make a furnace to do your particular job.





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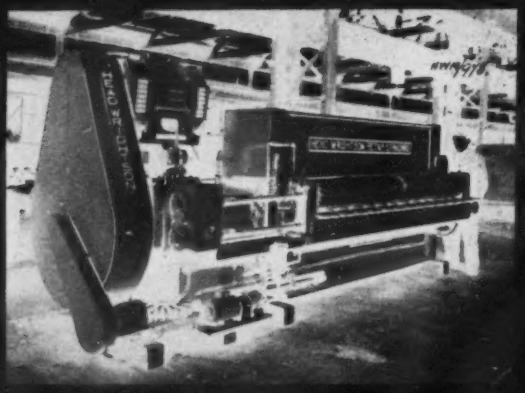
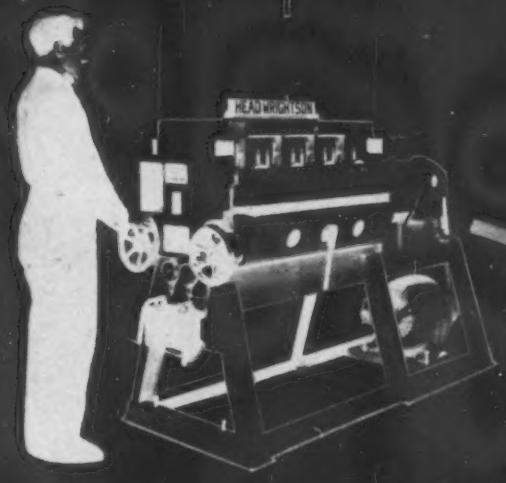
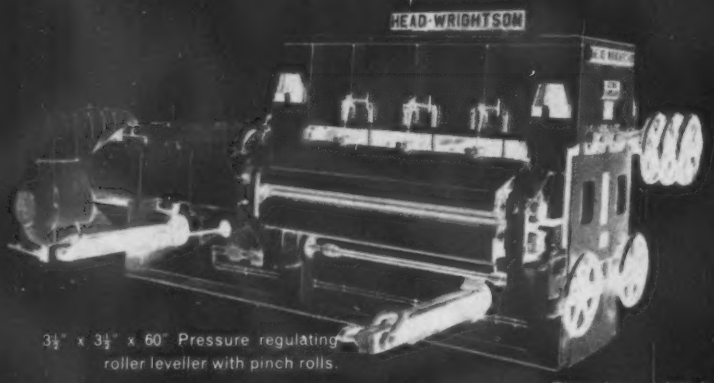


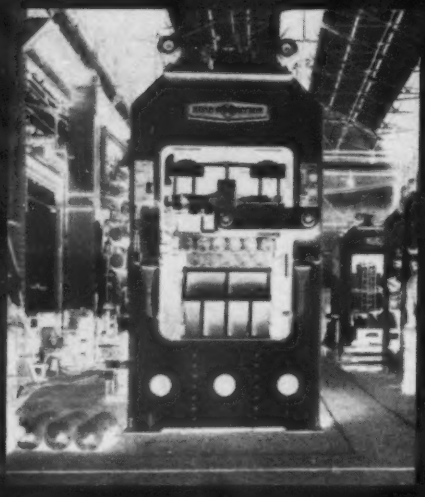
2½" x 2½" x 102"
Processor leveller.

1⅛" x 1⅛" x 36" Pressure regulating roller leveller, with four banks of back-up rolls for levelling aluminium foil.

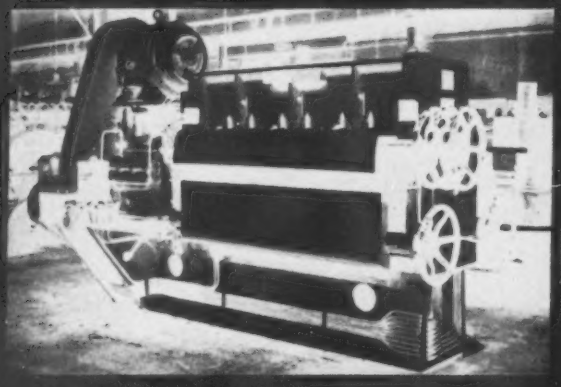




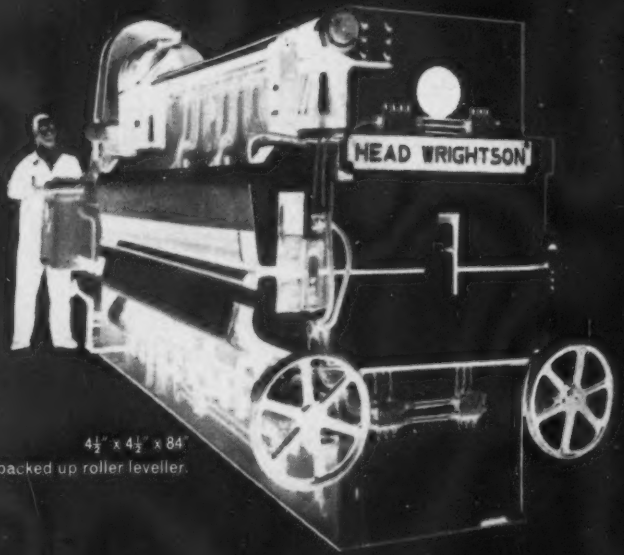
3½" x 3½" x 60" Pressure regulating roller leveller with pinch rolls.



Three heavy plate levellers capable of levelling plate 12ft wide by 2 inches thick being built at the company's works.



1¾" x 1¾" x 54" Pressure regulating roller leveller.



4½" x 4½" x 84"
backed up roller leveller.

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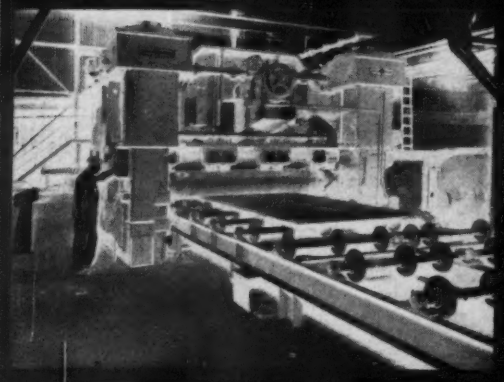
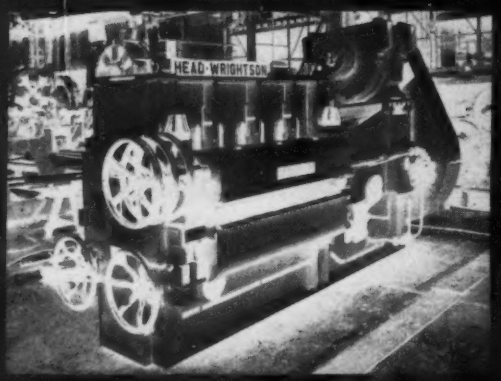
A heavy plate leveller in action at a shipyard handling plate up to 12' wide and 2" thick.





2½" x 2½" x 54" Pressure regulating roller leveller.

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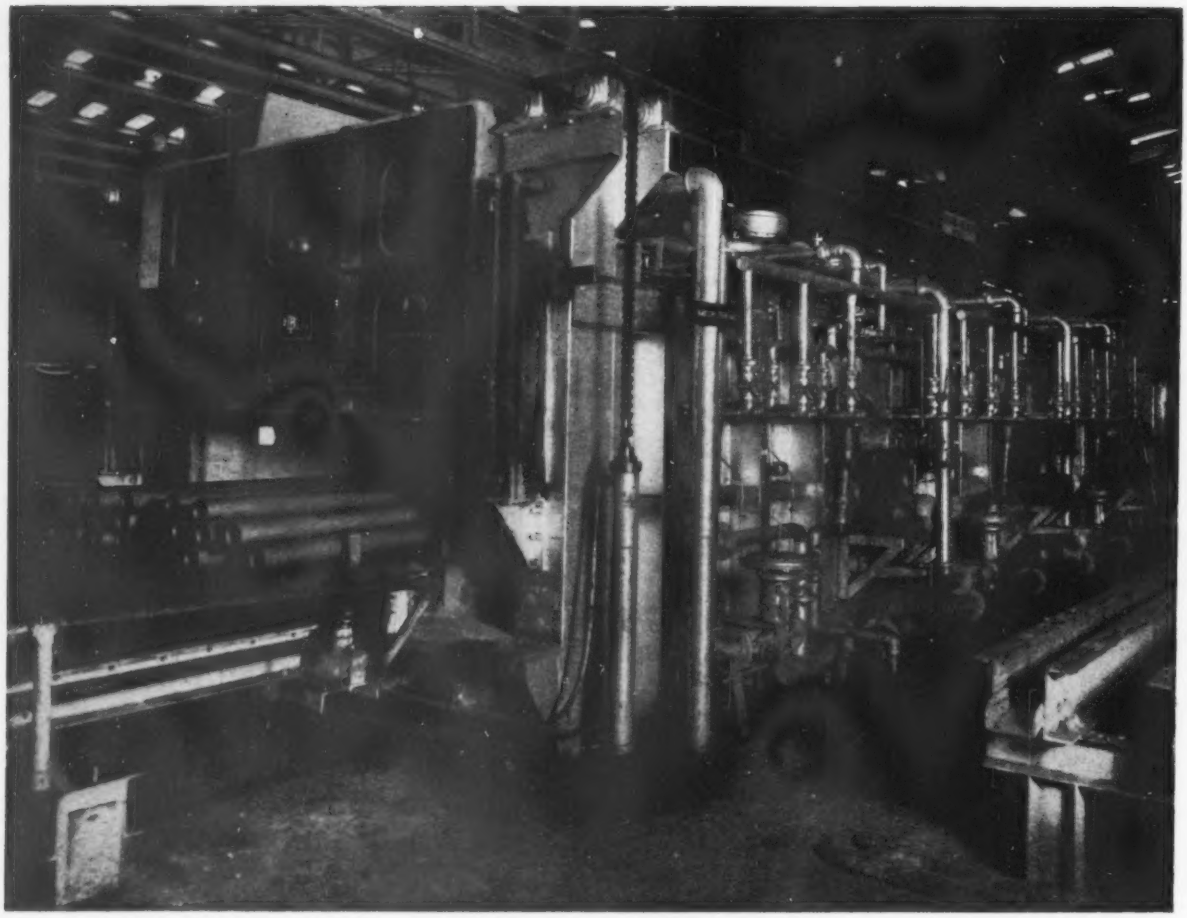

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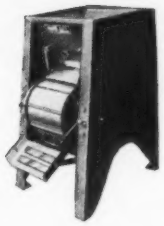

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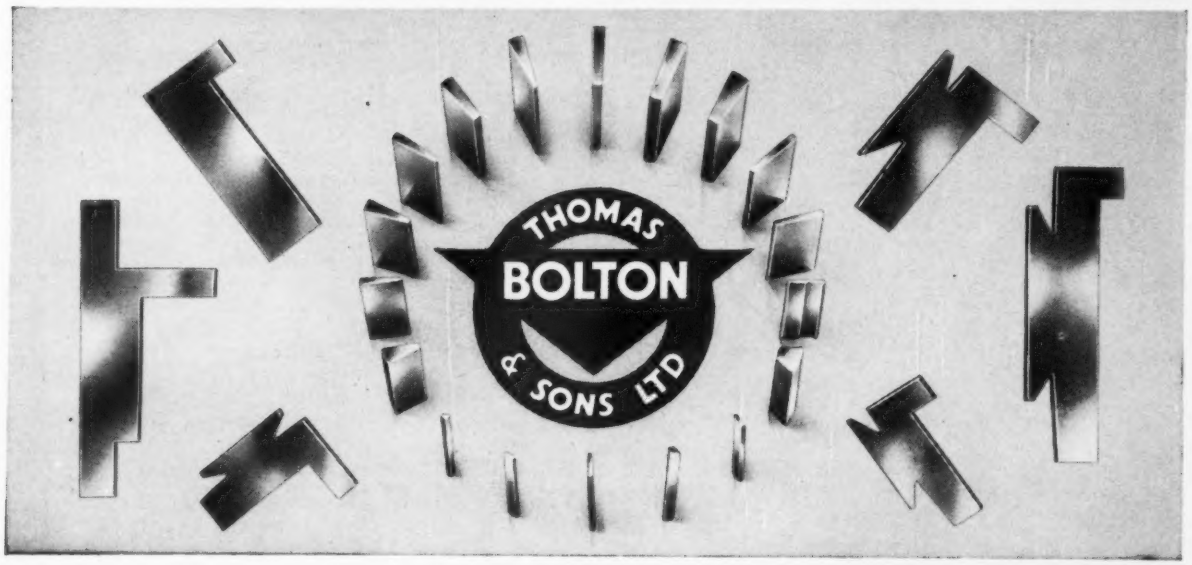

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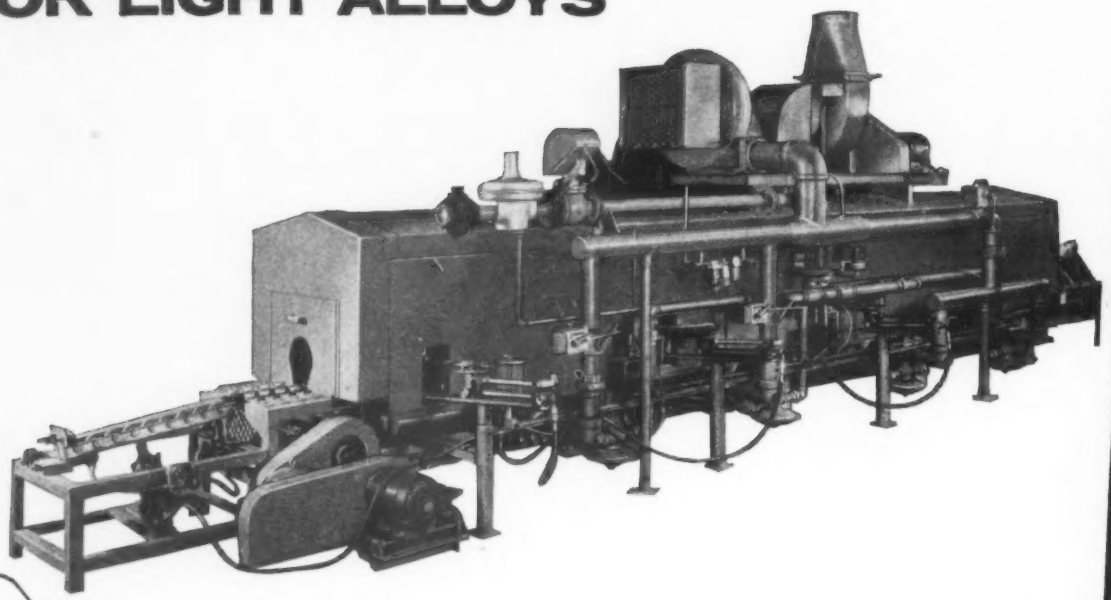

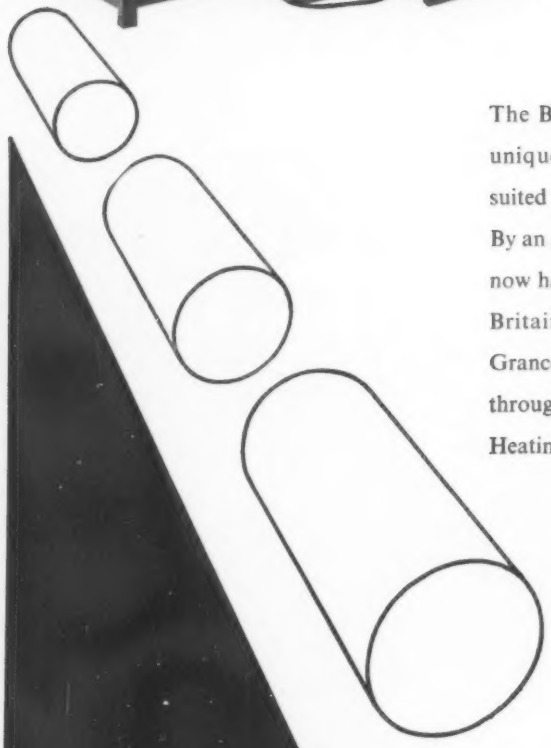

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EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

MANAGING DIRECTOR: ARTHUR B. BOURNE, C.I.Mech.E.

7 JULY 1961 VOLUME 99 NUMBER 1

CONTENTS

	Page
Editorial: Research for Industry	1
Pressing Aluminium. *By J. W. Lengbridge*	2
Low Oxide Copper Alloys	5
Products and Processes	6
Out of the Melting Pot	8
Sixth International Galvanizing Conference: Technical Sessions	9
Men and Metals	11
Bath Heating	12
Explosive Forming by Electrical Discharge	12
Obituary	12
Industrial News	13
Company Reports	16
Trade Publications	16
New Companies	16
Metal Market News	17
London	
New York	
Zurich	
London Metal Exchange	17
Non-Ferrous Metal Prices	
Primary Metals	18
Ingot Metals	18
Scrap Metals	18
Semi-Fabricated Metals	19
Foreign Quotations	19
The Stock Exchange	20

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PUBLISHED EVERY FRIDAY BY ILIFFE PRODUCTION PUBLICATIONS LTD.

Editorial Offices: 9 Charlotte Street, Birmingham 3. Telephone: Central 3206

Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Tel.: Waterloo 3333. 'Grams: "Metustry, London-S.E.1"

Branch Offices: MANCHESTER: 260 DEANSGATE, 3; telephone, Blackfriars 4412 and Deansgate 3595 BIRMINGHAM: KING EDWARD HOUSE, NEW STREET, 2; telephone, Midland 7191. COVENTRY: 8-10 CORPORATION STREET; telephone, Coventry 25210. GLASGOW: 62 BUCHANAN STREET C.1 telephone. Central 1265/6

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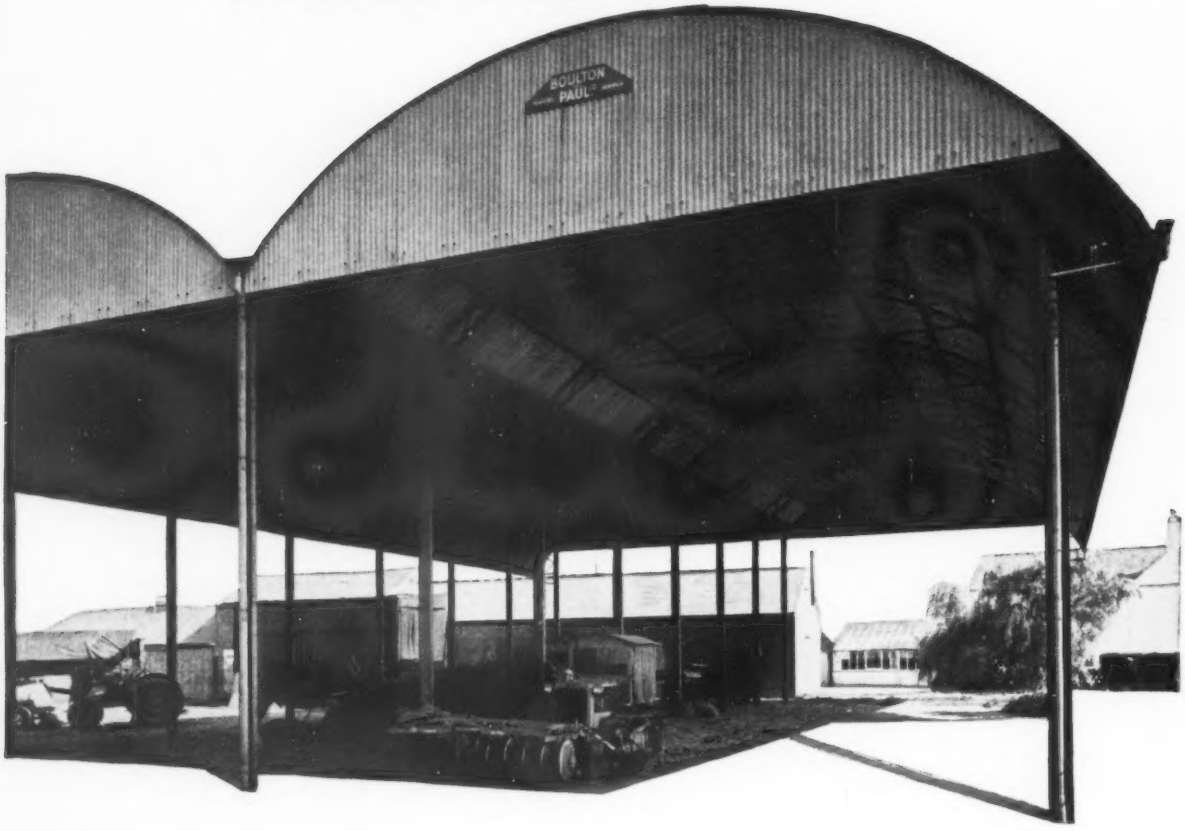

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METAL INDUSTRY

VOLUME 99 NUMBER 1 7 JULY 1961

Research for Industry

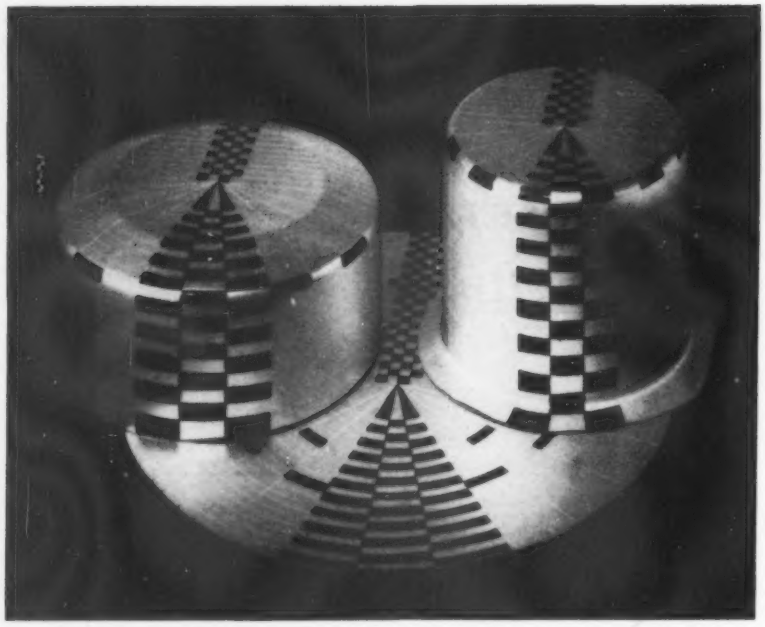
GRANT-AIDED research organizations now number fifty-two with a total income from industry and Government of £7·9 million, the contribution from the Department of Scientific and Industrial Research being £1·8 million. The rising costs of research are affecting all research associations, but particularly those grant-aided organizations serving small industries, the Industrial Grants Committee having to be satisfied that co-operative research schemes are "technically and economically sound before offers of grant are made". Practical co-operation between research organizations can help to minimize these costs. Subject to certain safeguards foreign firms may, if the industries so desire, be admitted to membership of one of the British industrial research associations. Such firms will have no voting powers and no grant will be payable by the D.S.I.R. in respect of any income from foreign sources. It has been the policy to encourage research associations to recruit Commonwealth firms into membership, no grant being payable either by the D.S.I.R. or Commonwealth Governments. Now, negotiations are to be opened with the latter to discuss the possibility of their paying grants to a research association in respect of any member firms from their respective countries.

The need to ensure that research results are conveyed to and applied by industry with the minimum delay has long been recognized by the Research Council, which allocated special funds with the object of accelerating the application of research in industry. By the end of 1959 fourteen schemes had been approved, and during 1960 a further six were added. Some associations have not been able to benefit from the scheme because they could not raise the necessary additional industrial subscriptions. The emphasis in most schemes is on the extension of liaison services and the practical demonstration of the application of research results.

Improved arrangements for research by the research associations into problems of industrial health and safety are being considered by the Committee and their report contains an account by Dr. A. H. Sully, Director of the British Steel Castings Research Association on current work in these fields. In his comments, Dr. Sully points out that the research associations can be divided into two groups in these matters: those serving industries dealing directly with the public and those serving industries that provide raw materials or components. Investigations by the former are of benefit to the communal health, those of the latter mainly to the workers in their industries. On the industrial side, three research associations—cast iron, steel castings and ceramics—have made assessments of atmospheric dust concentrations within their members' works and developed means of controlling dust generated in specific operations. Again, noise is an unpleasant concomitant of many industrial operations and in this connection the British Steel Castings Research Association has developed a novel design of bench for small steel castings which, in addition to controlling dust, also has a noise-absorbent hood which reduces the noise pressure level at the operator's ear by as much as 50 per cent when using pneumatic chisels on certain types of castings. Safety precautions to minimize skin burns and eye damage resulting from the intense ultra-violet radiation from welding torches have been studied by the British Welding Research Association, the British Iron and Steel Research Association is investigating protective clothing for workers subjected to intense thermal radiation, and other research associations offer advice to members on the safety precautions to be taken when using X- and gamma-radiography.

Pressing Aluminium

By J. W. Lengbridge



Blank marked in chequers and in sectors. It can be seen from the pressings that the lines are unaltered on the bottom, but have extended in both transverse and longitudinal directions on the sides

ALTHOUGH drawing operations are common in many manufacturing projects, they are among the most complex of metalworking techniques.

Unlike casting operations in which molten metal is poured or forced into a mould or a die cavity, or forging in which hot or cold solid metal is forced into shape between mating parts of the tools, the thin flat metal blanks in a drawing operation must be plastically worked to shape without the advantage of heat, liquid flow or the force of impact. The result must be a seamless, wrinkle-free shell having the same thickness as the original blank.

The proportion, contour, and thickness of the shell govern to some extent the methods to be used and the number of draws which will be necessary. All these factors must be evaluated in the planning stage.

Tests have established certain basic principles and experience has indicated rules of thumb around which the operations and the tooling must be designed. This applies particularly to the drawing group because of the many variables encountered in this type of operation.

As a general rule, the first step is to develop the size and shape of the blank necessary to make the shell, in order to determine the number of draws which may be required. With circular shells, blank size is calculated by formula solely on the basis of surface area. With non-circular shells, area and linear dimensions must be combined in a blank layout in order to produce a a blank which satisfies both shape and area.

The stresses in a drawing operation are directly proportionate to the magnitude of flow; consequently an accurate estimate of the area and shape requirements of the blank is essential. Oversize blanks involve abnormal stresses leading to high scrap loss. Undersize blanks necessitate stretching in order to gain area, which also leads to scrap.

The derivation of a commonly used formula for circular, unflanged, parallel-walled shells is shown in Fig. 1. It is based on dividing the contour into its shape elements, finding the area of each, and equating the sum of these areas to that of a circle. When the bottom corner radius of such shells is 1/20 or less of its diameter, the corner is presumed sharp for calculation purposes. With larger corner radii less metal is required and the other formulae may be used.

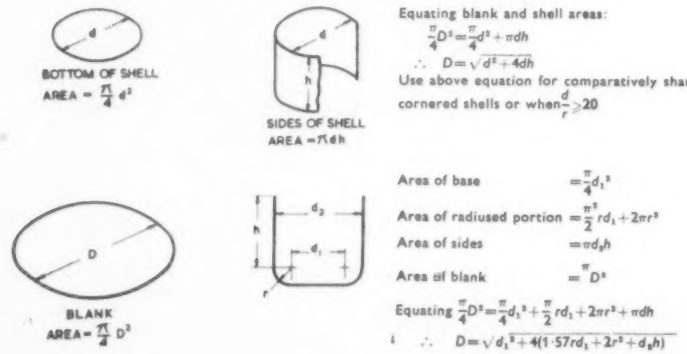
The same general principle can be used for quite complex shapes by making use of shape element formulae (Figs. 2 and 4). The area of side walls, flanges, bases, beads, etc. can each be calculated separately and the total thus obtained.

The blanks for non-circular shells involve shape development as well as area, and necessitate a layout along with some calculations. The stress and flow in such shapes are unbalanced and vary from zero to maximum along the periphery, and excess metal in the zones of maximum flow will induce high stresses and cause fracture. It is important, therefore, to have no more and no less metal than is necessary in these areas, and for reasons which will be shown later it is sometimes helpful to have a little excess metal in the zones of minimum flow.

The development method for a rectangular shell is shown in Fig. 3. A plan view outline of the shell is laid out, and the outline of the sides and ends added a distance h from the shell line. To determine the area requirements at the four corners it is assumed that the corner is part of a circular shell, and the blank size calculated accordingly. The radius of this blank is then fitted into the layout, and the side, corner, and end outlines blended together.

The blend line may be a straight line across the corner, a sweep curve, or a compound curve, depending on the general proportions of the shell. For a

Fig. 1—Method of calculating diameter of blank for cylindrical pressings



Equating blank and shell areas:

$$\frac{\pi}{4}D^2=\frac{\pi}{4}d^2+\pi dh$$

$$\therefore \quad D=\sqrt{d^2+4dh}$$

Use above equation for comparatively sharp-cornered shells or when $\frac{d}{r}\geq 20$

Area of base	$=\frac{\pi}{4}d_1^2$
Area of radiused portion	$=\frac{\pi^2}{2}rd_1+2\pi r^2$
Area of sides	$=\pi d_2 h$
Area of blank	$=\frac{\pi}{4}D^2$

Equating $\frac{\pi}{4}D^2=\frac{\pi}{4}d_1^2+\frac{\pi}{2}rd_1+2\pi r^2+\pi dh$

$$\therefore \quad D=\sqrt{d_1^2+4(1{\cdot}57rd_1+2r^2+d_2h)}$$

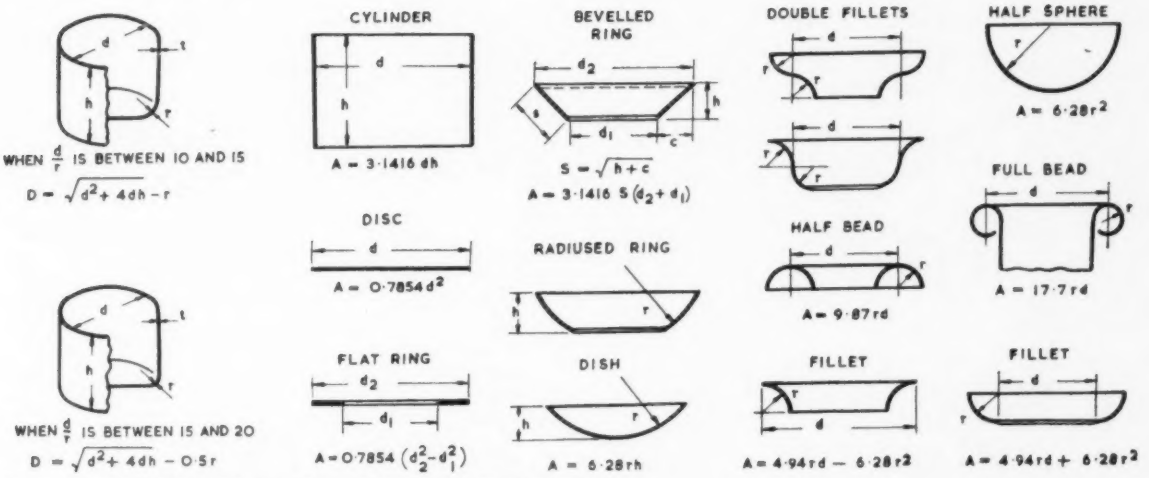


Fig. 2—Diameter of blank and areas of geometric elements of various pressings

complex non-circular blank development, each element is calculated separately, added to the layout, and the resulting outlines blended (Fig. 3). If the various corner radii of the shell are not particularly sharp, the straight line blending indicated by the dotted line may be quite satisfactory, and for very shallow shells it is often possible to use an uncut blank.

Developing a method of manufacture for a seamless shell is mainly a question of determining how to shape it. Supplementary operations such as trimming, beading, piercing, etc., do not as a rule present too many problems. The method may involve one or several draws, depending on such factors as shell proportions, contour, thickness, etc.

Circular shells require a different approach to non-circular shells, and the number of draws required will depend on the relative diameter of the blank and the shell. This ratio, in terms of the reduction percentage is a measure of the cold work involved in shaping the shell.

The generally accepted reduction limit for one draw, using annealed metal, is between 46 per cent and 48 per cent, and when the total reduction exceeds this value, more than one draw is necessary. When two or more draws are required, the reductions should be on a diminishing scale, as shown in Table I, because each draw work-hardens the metal and reduces its plasticity as well as its capacity for further severe cold work.

If the blank is thin in relation to its diameter, the limit of 46 per cent should be lowered because of the high wrinkling tendency of thin metals.

Shell contour is also a factor necessitating extra operations even when the reduction is well below the limits. The reason for this is that substantial areas would be out of control if attempted in one draw, thus permitting wrinkle formation.

Flow problems can be analysed by scribing lines on the blank to divide it into area units, drawing a marked blank into a die and studying the changes to the shape of the units in different areas, an example of which is shown in the illustration at the head of this article.

Maximum size change occurs to those units located on the rim of the blank, and this means that these areas involve maximum flow and stress and would undergo maximum change to their mechanical properties. For this reason, the metal in the rim of the shell which was originally at the rim of the blank will be harder than metal closer to the base of the shell.

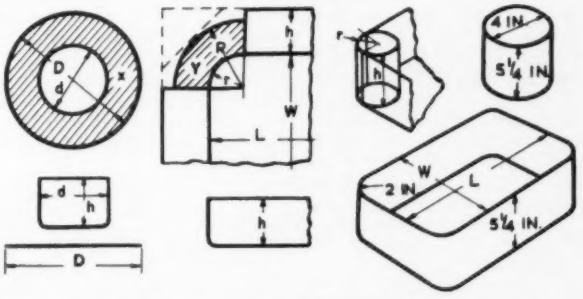
In circular shells the flow of metal is uniform around the periphery, and the stresses are balanced, and if the limits of plasticity are not exceeded and the tooling is properly designed, such contours are not usually too difficult to shape.

The effect of cold work on the mechanical properties of the metal is illustrated in Fig. 5. These curves

TABLE I—TYPICAL REDUCTION SCALE

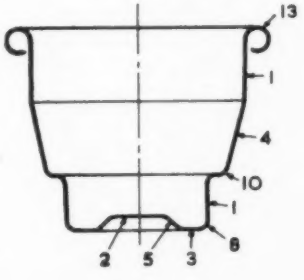
t/D per cent	Draws				Total Reduction
	1st	2nd	3rd	4th	
0·10	35	20	6	12	62
0·25	43	26	22	18	73
0·40	46	28	24	20	77
0·50	48	30	25	22	79

Right: Fig. 3—Analysis of a rectangular shell into elements for calculation

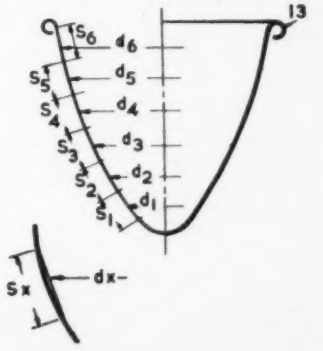


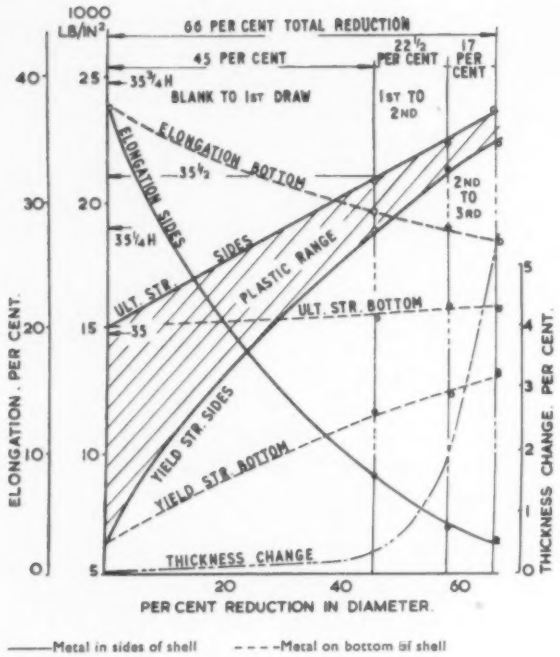
Below: Fig. 4—Examples of the analysis of a complex circular shell into its elements

1—Vertical walls. 2—Bottom. 3—Flat base ring. 4—Bevelled wall. 5—Radiused ring. 8—Bottom corner. 10—Double fillet. 13—Top bead
Total of these areas = A
$D = 1{\cdot}128\sqrt{A}$

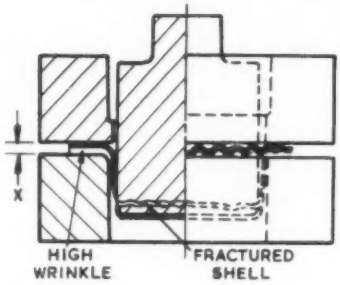


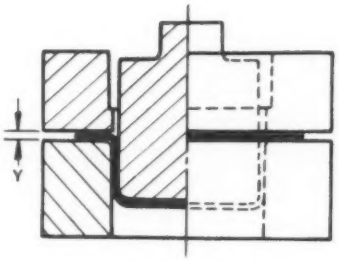
Top bead element 13 = 17·7rd
Radiused side walls area = $\pi(d_6S_6) + (d_5S_5) + (d_4S_4) + (d_3S_3) + (d_2S_2) + (d_1S_1)$
Bottom of shell element = 6·28rh
Total of above areas = A
$D = 1{\cdot}128\sqrt{A}$





Left: Fig. 5—Diagram indicating the cold working of a circular pressing as a function of the reduction in diameter





Right: Fig. 6—Beyond a certain degree of cold work, further drawing promotes tearing of the bottom end or the wrinkling of the flange depending on the adjustment of the blankholder

summarize the results of a three-draw test on aluminium, test samples being taken from the wall and base area of shells from each draw.

In any drawing operation, the metal must be stressed beyond its elastic limit to change the shape, but the stress must not exceed the ultimate strength, or fractures will result. These values rise as the metal is worked and the range between them, which may be described as the plastic range, is narrowed with each draw, indicating a loss of plasticity. The change in the base area is minor because no flow is occurring there, but is maximum in the wall area. In this test, the first draw raised the metal temper in the walls from dead soft to half hard and with each draw the metal became less plastic, as indicated by the narrowing of the plastic range.

Additional draws would eventually work the metal to a point where annealing would be necessary before further cold work could be done.

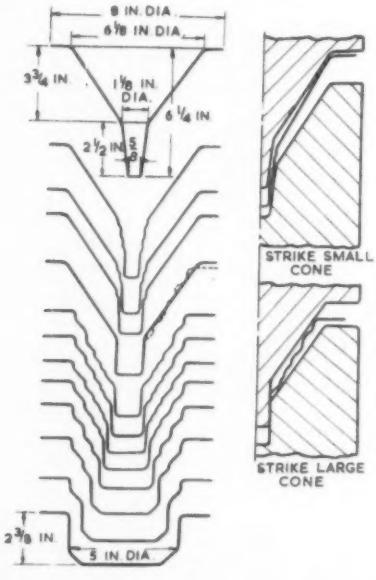
The stresses in the area moving toward the die radius are compressive and are tensile in areas which have moved over this radius. The compressive forces will cause wrinkling unless sufficient blankholding pressure is applied (Fig. 6). If, for any reason, flow is retarded by wrinkles, too much pressure, rough tool faces, lack of lubricant, etc., the punch must exert greater pressure to overcome the effect of the flow retarding elements, and if this pressure exceeds the strength of the shell section fractures will occur in the areas under tensile stress. Tapered shells, in general, require preshaping in step draws in order to produce a contour which can be struck to its finished shape in a final operation, and the steps should place the metal approximately along the wall taper to minimize splitting or wrinkling in the striking operation. When the wall taper is less than about 4° per side, the taper can usually be drawn without the need for step draws.

A funnel shape is very difficult to draw, for two reasons. First, the bowl is steeply tapered, requiring eight draws to shape, as in Fig. 7, and below this is the deep, small diameter spout, requiring five additional operations.

In spite of the number of draws required for a shape such as this, the press method can be quite economical if the quantity being made is large enough; for small runs it would be more economical to spin it to shape.

Non-circular shells require a somewhat different approach to circular shells because in addition to metal flow and cross sectional contour problems there are the added factors of proportion, such as length, width, corner radius and depth. The flow and stress are similar in both types of shapes, but are unbalanced in non-circular shapes and vary from zero to maximum over short portions of the periphery. The stresses in the corners are severe but diminish rapidly where the corners blend into the sides and ends, and this often permits drawing a greater depth, relative to the radius, than is possible in circular shells.

The point is illustrated in the per cent reduction of two shells, one circu-



Left: Fig. 7—Funnel-shaped pressing requiring 13 draws, 8 for the bowl and 5 for the neck

Below: Fig. 8—Diagram showing that cylindrical shells require more draws than non-circular shells whose corners have the same radius of curvature

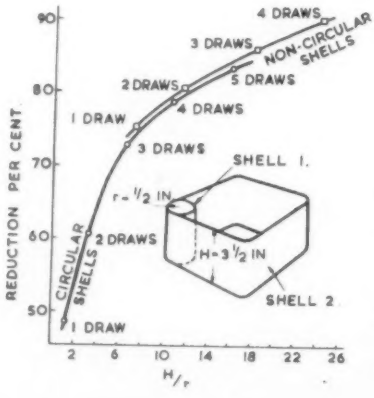


TABLE II—RATIO VALUES

Shell No.	1	2	3	4	5
h/r	6	6	6	6	12*
w/r	5	7	5	2·5*	5

* *Values in critical range.*

TABLE III—DRAWS REQUIRED

Basic h/r value	h/r range	No. of draws
6	up to 7	1
12	7-13	1 or 2
17	13-18	2 or 3
22	18-24	3 or 4

lar and the other rectangular, plotted against the h/r ratio, Fig. 8. Both shells have the same radius and depth. The blank for circular shell No. 1 would require three draws to reduce it to a shell 1in. diameter by 3½ in. deep. The rectangular shell, No. 2, having the same radius, could be drawn to the same depth in one draw because the stresses localized in the corner are relieved in the blending area.

Tests have indicated that the most consistent factor governing the number of draws in non-circular shells is the ratio of depth to corner radius, and that the maximum h/r ratio for one draw is about 7.

Assuming that the h/r ratio is within the one draw range, increasing the length or the width will not, as a rule, increase the difficulties to a point where more than one draw will be necessary. Decreasing the width, however, could result in extra draws because the corners would be close together and the high stresses more concentrated. Increasing the depth increases the h/r ratio, which is the most critical factor and would, if above 7, result in extra draws being necessary. The h/r and w/r ratios of these shells are given in Table II, and the ratio values, which are in the critical range and would most seriously affect the method of manufacture, are indicated with an asterisk.

Table III indicates the number of draws required for different values of the h/r ratio. These are nominal values which should, as mentioned earlier, be modified to allow for any and all the other factors which may affect the method of manufacture. For instance, in an oblong shape which has semi-circular ends and has a w/r ratio of 2, the h/r limit for one draw should not be more than 1·5.

With shells requiring more than one draw the final draw is usually more difficult than the pre-draws, particularly when the radius is small. In order to minimize these difficulties, it is advisable to arrange the pre-draws so that the amount of metal moving at the corners in the last draw is as small as possible.

Tooling for round and elliptical shells is shown on the right of Fig. 9. The deep reflector at the top is typical of the method used for deep-domed shells. This one needed three draws to reduce the blank to body size, two additional step draws, and a final striking operation. The important point in any step draw is to use liberal radii at the steps to avoid making the shell in these areas too thin, and to eliminate the need for heavy striking pressures. The tool below was used to produce a traffic light reflector of parabolic design, demanding carefully machined, highly polished and well-matched tool faces.

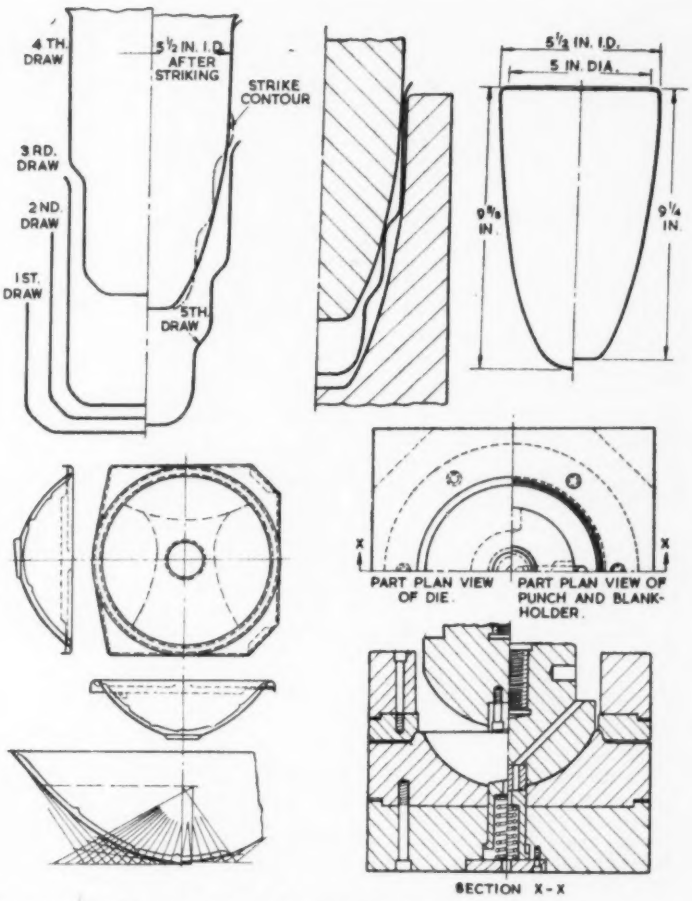


Fig. 9—Examples of drawing a deep-domed shell and a parabolic reflector

When the reduction from the first to the second draw is uniform along the entire periphery, by making the contour of the first draw sweep close to the corner of the final draw, the area being moved is reduced considerably. In other words, by reducing the magnitude of flow in the highly stressed areas, the stresses are reduced and the operation simplified.

(To be concluded)

Low Oxide Copper Alloys

A STUDY of the changes in creep rupture properties of two as-extruded, internally oxidized alloys as a function of increasing amounts of re-crystallization has been sponsored by the U.S. Air Force. The study, which included a review of subsequent cold work and investigated the strengthening mechanism in copper-silica and copper-alumina alloys, is reported by the U.S. Office of Technical Services.

Copper-silica and copper-alumina alloys of low oxide content were produced in the solid state research project by the internal oxidation and extrusion of copper-silicon and copper-aluminium powders. These alloys showed normal behaviour after recrystallization but with increasing amounts of recrystallization at temperatures up to 1,050°C., the creep rupture strength at 450°C. decreased and the ductility increased.

Cold work of the partially or completely recrystallized alloys resulted in an increase in creep rupture strength and a decrease in ductility. The report notes that the strength of dispersed oxide hardened alloys of this kind is due to a combination of micron or submicron dispersion of an insoluble oxide and a high value of stored energy through cold work. In the as-extruded condition, both the dispersion and the cold work impeded the dislocation movements. After recrystallization, the only impediment to dislocation movement was the oxide dispersion. Improved ductility and higher creep rates resulted.

Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

Induction Heating Processes

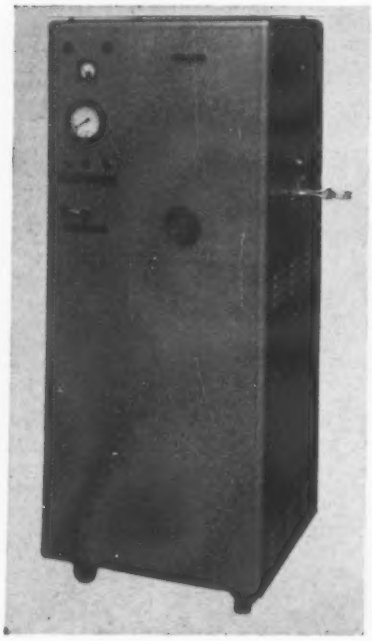
WITH the growing application of induction heating to an ever-wider range of industrial processes, a 12 kW generator, manufactured by Pye Ltd., available in either air- or water-cooled versions and designed for continuous operation, should be of interest to many firms.

The availability of medium and high work coil kVA permits the heating of a wide range of ferrous and non-ferrous loads. The output power can be varied by means of a stepped control. Accurate repetition work can be carried out as a result of the inclusion of an automatic resetting process timer. The safety devices include water pressure switches, overload relays and safety switches behind movable panels. Provision is made for remote output power indication and on/off control, also coloured indicator lamps show which circuits are switched on. Due to the simplicity of operation, unskilled labour may be employed, enabling production costs to be reduced.

Improving Edges of Strip

EDGE trim can be eliminated, speed of manufacture increased and the quality of the finished product greatly improved by automatically positioning the edge of reel fed materials. The Wadsworth-Lock edge or line guiding equipment, designed for this purpose, consists basically of a sensing head and a completely independent hydraulic ram control unit which is capable of adjusting very quickly in a lateral direction the position of reels weighing from a few pounds up to several tons. Alternatively, webs of moving material can be positioned by using the hydraulic ram unit to operate a roller guider.

A number of edge or line sensing units are available, including a pneumatic detector and a fully transistorized electronic print line tracking unit which can guide a web at speeds up to 1,500 ft/min. from a continuous or broken line printed on the web.



Left—The Pye 12 kW induction heating generator

Below—Wadsworth-Lock edge guiding equipment controlling a slitting machine

The pneumatic and electronic sensing heads, as well as the hydraulic ram positioners, have been carefully designed and engineered to ensure reliable, trouble-free operation under arduous industrial conditions. Automatic edge positioning can be used to advantage in many industries, as well as those concerned with strip metal.

Resin for Core Blowing

A PHENOLIC resin, offering considerable advantages in the "hot box" core blowing process, is now being produced by British Resin Products Ltd.. Offering foundries the advantages of a single resin system, Cellobond J.1011 is a liquid phenolic resin for making solid cores blown into a hot mould using a wet mix. No catalyst or hardener is used, and heat alone cures the mix. Metal/mould reaction is reduced, and this resin will not give off any unpleasant odours during core blowing.

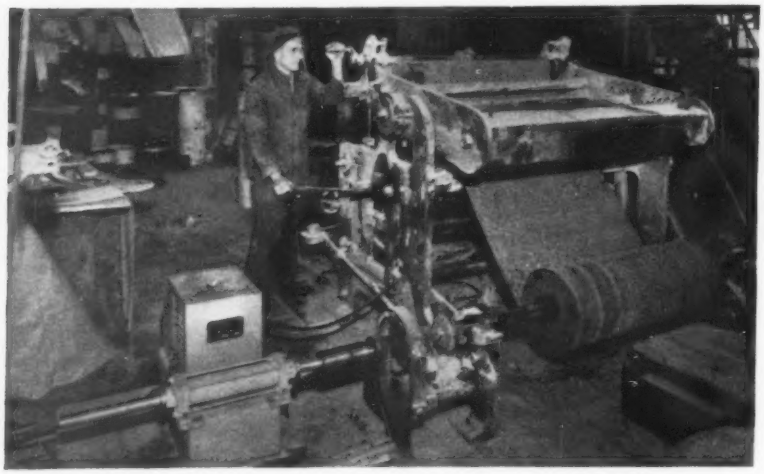
Tribenzylamine in Metal Processes

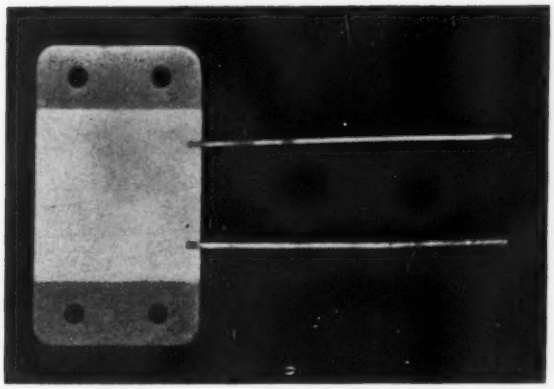
NOW available in pilot plant quantities, tribenzylamine is a solid and is water insoluble with a hydrochloride which is almost insoluble in cold water. It is available from Robinson Brothers Limited, and has potential application as an amine catalyst in reactions where ease of separation of the catalyst is desired, in copper plating, and as a corrosion inhibitor.

It has been used, in chloroform, in the liquid/liquid method of separation of metals. By this means, niobium can be separated quantitatively from tantalum, and polonium and plutonium can be extracted from solutions of their hydrochlorides. As a corrosion inhibitor, tribenzylamine is a very good cationic type of organic inhibitor of the corrosion of iron in acid solutions when used along with cathodic polarization.

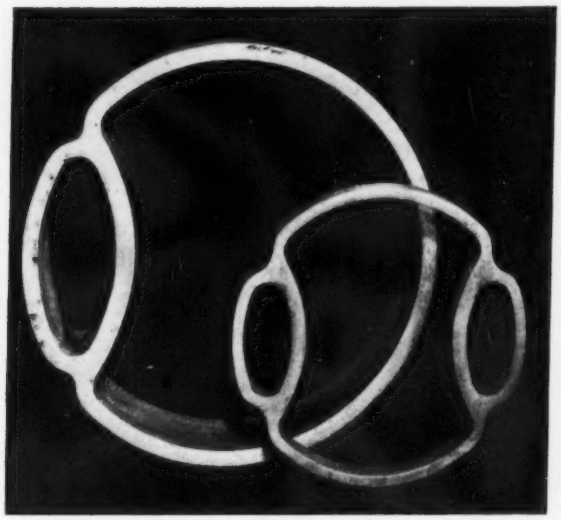
In copper plating, uniform, non-porous and coherent copper deposits on iron from acid baths can be obtained by using a solution made up from 200 gm/L. copper sulphate pentahydrate, 100 gm/L. sulphuric acid (S.G. 1·84), 0·1 gm/L. tribenzylamine, 0·005 gm/L. thiourea.

Operating conditions are as follows: current density, (a) steady solution 2-3 amp/dm^2, (b) stirred solution 5-10 amp/dm^2, temperature below 25°C., current efficiency 100 per cent, cathode potential 0·14+0·1 V, anode potential, 0·40





Above—An RdF 'Stikon' fine wire resistance thermometer of the type for riveting or screwing to a surface



Right—Sections through Alcoa "Unitrace" and "Duotrace" tubes

and 0·44 V, throwing power 28 per cent, specific conductivity 0·3 ohm^{-1} cm^{-1}.

The temperature has to be kept below 25°C. because of decomposition of the thiourea.

Versatile Resistance Thermometer

NOW being made available in this country by West Instrument Ltd. is a range of products manufactured by the RdF Corporation of U.S.A., including resistance thermometers, mounted probes, and comparison and conversion bridges. Of particular interest are the RdF "Stikon" resistance thermometers, which are supplied with adhesive sensing grids or with grids suitable for riveting and cementing, and the RdF "Strapon", a resistance thermometer mounted on a steel strap which is suitable for pipes and tubes.

These transducers are characterized by milli-second response and an uncommonly high degree of accuracy and stability. Unusual in the performance of the resistance thermometers is that they will function perfectly from near absolute zero to 2,000°F.

Dual Channel Tube

DESIGNED for use in the processing of chemical and food products, "Unitrace" extruded tubing, manufactured by the Aluminum Company of America, combines two integral channels, the larger for the product line, the smaller for the tracer line carrying the heating or cooling medium. It is now being marketed in this country by Imperial Aluminium Company Limited. The tubing is light and easily bent but has considerable strength and the integral construction provides excellent thermal characteristics. It is supplied in standard 30 ft. lengths and in seven standard sizes from 1 in. to 8 in. Outside diameter of the tube conforms to standard pipe sizes so that normal insulation can be fitted. Special flange fittings enable lengths to be bolted together by standard flanges or to jacketed fittings by means of adaptor flanges.

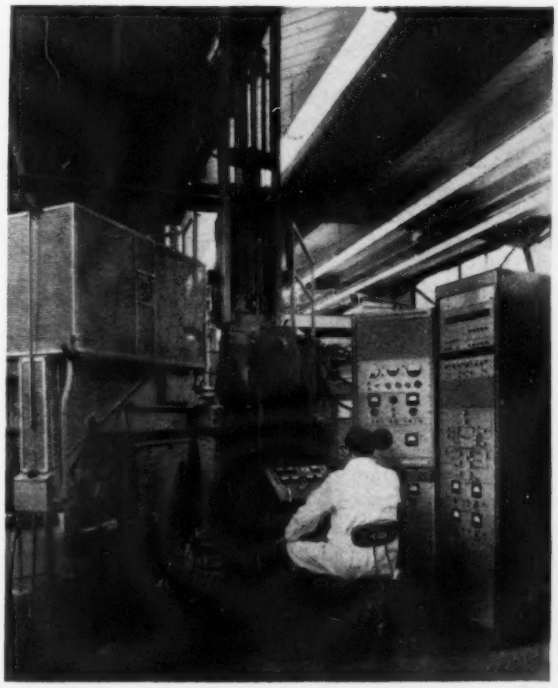
Tracecaps enable welded joints to be made on straight runs, tees and cross-connections. Right-angle elbows, having trace lines at the side, outside or inside, are available. The range now also includes "Duotrace", with two tracer lines instead of one.

Greater Production of Refractory Metals

A 300 kW ELECTRON beam furnace, capable of refining and casting ingots of refractory metals up to 8 in. in diameter and 42 in. in length, has been placed in commercial production at the Richmond, California, plant of Stauffer Metals Division of Stauffer Chemical Company, New York. The recently completed furnace is the first constructed for high output capacity — approximately 30,000 lb/month — and incorporates several new features. These include vacuum load locks, ingot casting and unloading systems, and feed-material handling equipment.

The added capacity of the new furnace raises the total United States capacity for the production of electron beam refined refractory metals to more than 200 tons/yr. A high degree of purification coupled with grain refinement, with concomitant increase in ductility and ease of fabrication, is generally the most significant result of electron beam refinement. In addition, the process provides substantial economic advantages over partially competitive processes, such as vacuum arc melting, since the electron beam furnace does not require a high grade feed stock; it can be charged with mill scrap, fines, metal powder or sinter. The furnace operates at temperatures in excess of 3,320°C. (6,000°F.) and in a vacuum as low as 10^{-4} mm Hg.

The controls of the 300 kW electron beam furnace



OUT OF THE MELTING POT

Including Oxide

NOW that the presence of oxide inclusions (suitably dispersed, of course) in powder metallurgical products is no longer regarded as invariably undesirable, increasing interest is being taken in the possible ways and means of providing for their being present. Addition of oxide to the original powder or mixture of powders has not, so far, proved very satisfactory, unless steps are taken for its really thorough incorporation by prolonged ball milling. The possibilities of internal oxidation of originally all-metal products are limited, and its results not very promising. More and more attention is therefore being given to the other method of introducing oxides into powder metallurgical products, viz as an integral constituent of the metal or alloy powders. Some metals are more fortunate in this respect than others, in that oxide is always naturally present in them. Whereas formerly as, for example in the case of aluminium, this was the cause of much worry, with much earnest endeavour directed towards the elimination of this oxide, it is now accepted as a blessing which, moreover, can be multiplied, as required, by certain adjustments to the conditions under which the powder is produced. Where oxide is not present naturally, it can sometimes be introduced by selecting a suitable alloy composition, and then internally oxidizing the alloy powder, a procedure that has proved much more effective than the internal oxidation hardening of the finish material or of finished products (cf. this page, METAL INDUSTRY, 12 May, 1961, p. 370). If necessary more drastic steps may be taken to ensure the formation of the required amount of oxide during the manufacture of powders. Thus, in the case of chromium-nickel steel, nickel-cobalt, nickel-chromium and chromium-cobalt alloys, powders having a uniformly dispersed oxide content of 0·05 to 1·5 per cent can be obtained by atomizing a stream of the molten metal by an annular stream of water impinging under suitable conditions and then allowing the atomized powder to fall a controlled distance through an oxidizing atmosphere before entering a quenching bath. Other opportunities that present themselves and still remain to be investigated in detail include the use of thermite-type reactions in suitably composed (non-stoichiometric) mixtures, partial hydrogen or other reduction of metal oxides, etc., and suitable control of conditions (periodic current reversal, anodic oxidation?) in the case of the electrolytic process of manufacturing metal powders.

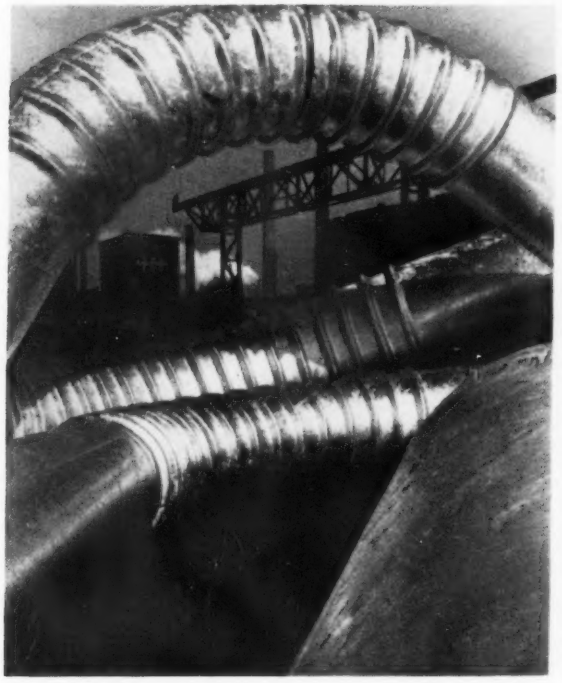
To the Present

PLANNING is primarily concerned with the future; its concern with the present is nil. True enough, the present cannot be planned. As the only finite evidence of the success or otherwise of planning, it is, however, of great interest. The past is but a trend; the future as yet but a plan, whereas the present is the result of all the planning that has gone before. Or is it? Perhaps, in spite of all the planning that there certainly has been, the present was still not planned for adequately; hence the unsatisfactory results and hence, presumably, the emphasis on more and better planning for the future. That is one possible reason for the lack of interest in the present: it is not representative of what planning can do; it is still largely a product of chance. On the other hand, assuming that the present is largely the result of past planning, it is perhaps ignored because of the shocking advertisement for planning that it is. Indeed, judged on the basis of such results, planning would have been abandoned a long time ago. The only reason why it has not, is its undoubted reasonableness and the absence of any immediately apparent alternative. This need not mean, however, that planning should not at least be reviewed in the light of results to date. These suggest that even if there is nothing wrong with planning, its facts and figures and its practice, there may be something wrong with its principles. Indeed, given the right principles, they might even be found useful in dealing with the present rather than planning for the future.

More Modification

EXTRUSION (this page, METAL INDUSTRY, 26 May, 1961, p. 410), rolling (this page METAL INDUSTRY, 16 June, 1961, p. 470) and now billet piercing of metals and alloys that are difficult to deform, are following one another along the same road towards a solution of their difficulties by modification of the conditions of the flow involved in the deformation. In piercing billets of such metals as molybdenum, zirconium, titanium or tantalum, or of high-alloy steels, it has been found that even when a lubricant is used, very often defective zones, e.g. in the form of transverse cracks, are formed on the internal surface of the hollow billet by the forcing of the mandrel into it. These defects are accentuated by the subsequent elongation of the pierced billet for the production of a tube, and therefore have to be eliminated in advance by drilling out the billet after piercing. The formation of these defects during piercing is connected with various factors such as the cooling action of the piercing mandrel, the variation of the ductility of the metal with temperature, local temperature variations in the billet, the characteristics of the lubricant being used, etc., all of which are difficult to control. It has now been found that an internal surface free from defects can be ensured in pierced billets by placing a disc of metal, which is more easily deformable than the material of the billet, on the end of the billet so that the piercing mandrel has to pass through the disc before entering the billet. The metal of the disc must have a melting temperature higher than the temperature to which the billet is preheated for piercing. Conveniently, the disc and the billet are preheated together, the disc preferably being welded to the end of the billet by a circumferential seam. As in the case of flow-modifying methods of extrusion and rolling, the thickness of the disc must bear a certain relation to the height of the billet. It must be such that the hole produced in the billet by the mandrel is covered over its entire length by a coating of the disc metal which is drawn into the hole by the piercing mandrel. This coating may subsequently participate in the drawing of the pierced billet into a tube. It can be removed, or it can be left to form a permanent lining in the finished tube. The principle of using a disc to facilitate piercing can also be used in the manufacture of tubes by extrusion, in which a tube is extruded from a billet directly after the latter has been pierced in the extrusion press.

Steinmetz



Sixth International Galvanizing Conference

(*Continued from* METAL INDUSTRY, 30 *June*, 1961)

AT the Sixth International Galvanizing Conference, organized by the Zinc Development Association and the Swiss General Galvanizers' Association, the technical sessions covered a wide variety of topics.

With **Mr. C. Origoni** (Italy) in the chair the effects of alloy additions, bath temperature, immersion time, aluminium concentration, agitation and cooling on the properties of hot galvanized coatings, formed the subjects of discussion at the sixth session. Four Papers, abstracted on this and the following page were presented.

All the authors of the Papers did not seem to be in complete agreement, said **Mr. R. C. Bell**. Apart from aluminium and lead no elements contributed significantly to the coating except as regards appearance. This improvement was not gained without loss in other properties. What was needed was an element which would give improved corrosion resistance.

This latter could be obtained, claimed **Dr. S. Radkte,** by the addition of 0·04-0·05 per cent of magnesium which improved resistance to corrosion up to 50 per cent without affecting mechanical properties or the galvanizing process itself.

The effect of copper on coating thickness was mentioned by **Mr. A. Bianchini** who said that at a temperature of 450° C. with 1·70 per cent copper and 0·07 aluminium, layers of 90μ were obtainable as compared with 30μ with no copper and 0·22 per cent aluminium. A marked increase in resistance to corrosion was obtained by the addition of copper up to 0·08 per cent although the appearance of the deposit deteriorated.

Sebisty and Palmer stated, said **Mr. H. Edwards,** that corrosion is dependent to a major degree on the presence of aluminium in the coating, while Rädeker, Peters and Friehe stated that in proportion to its concentration, aluminium increases the tendency to wet storage stain. This effect was noticeable at 0·06 per cent Al, but was still only slight at 0·15 per cent Al. Atmospheric corrosion was greatly increased by aluminium additions and reached a maximum at a concentration of 0·40 per cent Al. Wilcox and Dismuke's stated that their work gave some quantitative support for the often expressed view that wet storage stain is more severe on continuously galvanized strip which usually contains aluminium in the coating. The evidence would

The Influence of Alloy Additions on Hot Galvanizing

By J. J. SEBISTY and R. H. PALMER

THE most important single factor affecting the thickness, structure, forming properties, surface appearance and storage-stain susceptibility of the experimental coatings was the aluminium content of the bath. Bath temperature and immersion time modified the behaviour of aluminium.

With 0·15 per cent or higher aluminium in the bath, it appears that up to 0·60 per cent each of tin, cadmium and copper, and 0·04 per cent antimony, separately and in combination, have relatively little effect on coating properties so long as the immersion time is short and the bath temperature is at or near the optimum of 450° C.

For lower aluminium concentrations, no improvement in the bascially poor forming properties of such coatings can be expected even with excessive additions of tin, cadmium, antimony and copper to the bath.

The only practical advantage to be expected from deliberate alloying of the bath with tin, cadmium and antimony is the production of a lustrous spangled finish.

Tin or cadmium at high concentrations in excess of 1·0 per cent appears to be ineffective in promoting appreciable spangle growth with lead-free baths. However, a much superior response can be obtained with significantly smaller amounts when 0·5 per cent Pb is also present.

A high lead content is beneficial in promoting brighter coatings, but an accompanying disadvantage is a reduction in surface smoothness due to depression of spangle boundaries. Addition of tin and/or cadmium in amounts of the order of 0·60 per cent appears to offer an alternative solution.

Copper promotes more rapid zinc attack on the steel surface and is also detrimental to coating surface appearance.

Storage-stain susceptibility tests demonstrated that such corrosion is dependent to a major degree on the presence of aluminium in the coating. Tin, cadmium, antimony and copper are somewhat less detrimental, but the concentration of these should be limited in coatings where resistance to this type of corrosion is desired.

appear to be definite but the statements should be accepted with some reserve for under some conditions the effect of aluminium has not been found.

Souske states, it has been demonstrated that it is possible to produce by conventional sheet galvanizing methods, coatings which have properties similar to those of continuously galvanized strip; but there is no mention of the difficulties of maintaining controlled aluminium contents when flux is used.

In reply, **Mr. J. J. Sebisty** said that copper up to 1·0 per cent could be safely tolerated. It did, however, have an effect on the Fe-Zn phases, the granular structure appearing at lower temperatures when copper was not present. Copper produced a staining effect which was detrimental in galvanized strip. In answer to **Mr. H. Edwards** he said that the white rust tests were carried out on base sheet as opposed to chromate-treated sheet.

With aluminium in amounts of 100 gm/ton of zinc increased thicknesses of up to 20 per cent could be obtained, said **Mr. R. Souske,** with normal immersion times of 20-50 sec. at a temperature of 450°C.

Bath Heating

Bath heating occupied the attention of delegates at the seventh session when three Papers were presented, **Mr. C. P. H. Wedge** (United Kingdom) being in the chair. The Papers were: "Some Aspects of Bath Heating," by F. N. Hodgetts, "Industrial Experience with Top Heated Baths," by K. H. Fritz, and "Technical and Operating Data for Some Top Heated Baths," by F. Teichmann.

Dr. R. Haarmann, acting as Rapporteur, said that these Papers brought out the fact that there was no universal solution for the heating problem. Although throughput had increased enormously in the last 10-15 years no new inventions had appeared since the last conference.

The Paper by F. N. Hodgetts emphasized the progress made in gas and oil heating but the figures given for relative costs were only valid for Great Britain. In Germany, heavy oil could be obtained at lower cost, the only disadvantage being the cost of preheating. He also doubted the figures given for pot life (9-10 years).

In discussing Hodgett's Paper, **Mr. E. M. Wilson** said that the problem was to reduce soaking time. Unfortunately

The Effect of Alloy Additions on the Properties of Hot Galvanized Coatings

By W. RADEKER, F. K. PETERS and W. FRIEHE

TIN has no effect on coating thickness or on the formation of zinc-iron alloys. The ductility of the coating is slightly affected, but its adhesion during deep drawing is still good. The tendency to form wet storage stain remains unchanged, while atmospheric corrosion resistance is reduced by about 10 per cent irrespective of the amount of tin present.

Cadmium is similar to tin in its effect except that small amounts of cadmium slightly inhibit wet storage stain formation, while atmospheric corrosion resistance is greatly improved.

Copper reduces coating thickness in proportion to the concentration, although the formation of zinc iron alloys does not seem to be affected. Ductility and coating adhesion during deep-drawing operations are adversely affected, although there is some improvement at copper contents above 0·3 per cent. Additions of copper greatly increase the resistance of the coating to atmospheric corrosion and probably also reduce its tendency to form wet storage stain.

Aluminium rapidly decreases coating thickness to a limiting value obtained with a concentration of 0·2 per cent. Coating adhesion during deep-drawing operations and ductility are improved with aluminium additions up to 0·3 per cent, while further additions effect a decrease in these properties.

In proportion to its concentration, aluminium increases the tendency to wet storage stain. This effect was noticeable at 0·06 per cent Al, but was still only slight at 0·15 per cent Al. Atmospheric corrosion was greatly increased by aluminium additions and reached a maximum at a concentration of 0·4 per cent Al.

The net effect of combined additions of aluminium and copper is a summation of the effects of the individual elements.

Influence of Bath Temperature, Immersion Time and Aluminium Concentration on the Structure and Properties of Galvanized Coatings

By R. SOUSKE

IN the experiments the conventional dry process, using 99·95 per cent Zn, was used to galvanize specimens of cold rolled Siemens Martin steel. The galvanizing temperature was varied between 440°C. and 500°C.; immersion time between 10 and 120 seconds; and aluminium concentration between 0·01 per cent and 0·10 per cent.

Coating weight increased with increasing time, but the trend was reversed when the zeta alloy ceased to form.

The maximum coating weight is obtained at a 0·01 per cent aluminium concentration for specimens galvanized at 450°C. for 20 seconds.

With prolonged immersion, the coating weights obtained in baths containing aluminium, particularly 0·05 per cent and 0·01 per cent, may, in fact, be heavier than the coatings formed under similar conditions in baths containing no aluminium.

Coatings with a thin zinc layer and no delta or zeta layers may be prepared by immersion of the steel for 10 seconds in zinc containing 0·1 per cent Al at 460°C.

Cupping tests showed that the coating ductility is chiefly influenced by the delta alloy layer and relatively small changes in bath temperature and immersion time can have a marked effect on coating adhesion.

The Effects of Agitation, Cooling and Aluminium on the Alloying Behaviour in Hot Dipping in Zinc

By D. I. CAMERON and M. K. ORMAY

THE experiments described cover the temperature region 440-450°C. for aluminium contents between 0 and 10 per cent for times from five seconds to two hours, with and without agitation. Almost all samples were water quenched, but in addition the effects of varying cooling conditions were investigated.

When aluminium is used in galvanizing baths, the amount of agitation, the speed of cooling and the degree of saturation can be important variables in behaviour. Their importance varies with the aluminium level, being most important in the range 0·08-0·25 per cent Al.

In a fresh bath below dross saturation, dissolution of the steel base or alloys can occur, but this can also happen for high iron activity phases in a dross-saturated bath, particularly if the aluminium inhibits alloy layer formation by suppression of the rapidly forming binary iron-zinc alloys.

During the induction period in the presence of aluminium, parts of the surface are dissolving with no alloy formation, but at isolated spots alloy layers are nucleated and grow till they cover the surface.

A number of effects, thought to be due to dipping conditions, have been shown to occur during cooling, and the consequences of agitation and bath saturation are also of more practical importance than has hitherto been realized.

The range 0·1 to 0·2 per cent Al is particularly susceptible to all these variable effects.

What has been found at a temperature of 450°C. should apply with the appropriate minor changes to other temperatures.

the kind of heating that can be applied to the bath sufficiently directly to give the minimum of soak led to local overheating, increased dross and shortened pot life. One solution was a gas-fired setting using a number of small burners to give relatively low intensity heat over the greatest possible bath area. This system applied to a deep bath has provided a good bath life, namely 60,000 tons of throughput in 6- 8 years.

They had recently installed a new patented system which was giving excellent results. With a conventional setting and a flue temperature of 650°-670°C. they had obtained a maximum output of 2 tons/hr. With the new furnace using 200 sec. oil, and a flue temperature of 580°C. they had achieved a throughput of 2½ tons/hr. With town's gas at the same flue temperature, tonnages up to 3 tons/hr. had been obtained. With throughputs greater than 3 tons/hr. higher temperatures were necessary. The difference between the inlet temperature and the return temperature for re-heating and re-circulation is approximately 50°C. and the surplus products of combustion passing to the heat exchanger to supply the drying oven reach the heat exchanger at a temperature of about 400°C. The fuel cost/ton, however, was not reduced but throughput could be increased without detriment to pot life. In their case by nearly 50 per cent.

In top-heated furnaces, said **Mr. J. Bradbury,** the maximum temperature above the zinc surface was limited to 900°C. Larger throughput, therefore, could only be obtained by increase of surface. In a new development with which his company was going ahead, known as the "jet tube" system, the metal pot would be eliminated.

In the gas-fired bath described by Hodgetts, said **Mr. D. M. Andrew,** he noted that the bath was supported on pillars and the gases passed under the bath to the main flue. It had been the practice to avoid bottom heat because of disturbing the dross. Did this change in design indicate less worry about dross adherence to products ?

In reply, **Mr. F. N. Hodgetts** said he did not recommend heating under the bath. They only exhausted gas by under-bath flues.

Referring to top-heated baths, **Mr. W. L. Hall** said if such a bath were used for galvanizing a reactive material such as cast iron or ordinary steel at high temperatures some dross must be formed. Could such dross be removed without damage to the refractory? Also, how did the refractory lining stand up to damage by the usual accidents which occurred in the galvanizing ?

With reference to the method of heating mentioned by Mr. Wilson, **Mr. Tancred** said that it was an all steel setting there being no refractory except in two small combustion chambers. Heat soak was less, all heat was transferred by convection and all four walls of the bath were heated in the same way. The volume of gases was larger than usual and a fan of low horsepower was used. The gases leave the fan at a temperature of 580°C., impinge on the bath well at 530°C. and return to the fan at 530°C. The volume is such that enough heat is transferred to the bath for galvanizing. The flue gas was at a temperature of 400°C. on the return side of the recirculating system, the temperature being measured by a pyrometer outside the setting. Bath replacement was easy. The only difficulty experienced so far had been with oils containing vanadium, which formed deposits in the hot gas nozzles.

Electric resistance heating was much used in Switzerland, said **Mr. R. Gloor,** offering the advantages of easy heat control and stand-by economics.

Editorial Note: The furnace mentioned by Mr. E. M. Wilson is described in more detail on page 12.

MEN and Metals

Newly appointed directors to the board of the Suffolk Iron Foundry (1920) Limited are **Mr. W. McAlpine** and **Mr. J. Cooper.**

News from The Birmingham Battery and Metal Company Limited is to the effect that their sales director, **Mr. H. W. Bennett** has now retired. The company's sales organization will in future be in the hands of **Mr. A. W. Gibbins,** deputy managing director.

Consequent upon the retirement of **Mr. Andre Trebucq** from the board of H. J. Enthoven and Sons, **Mr. A. E. Speijer,** general manager of N.V. Hollandsche Metallurgische Bedrijven, has been appointed a director.

A British Council sponsored visit to lecture at the University of Chile's Postgraduate Engineering Winter School in Santiago is to be made by **Dr. T. P. Hoar,** Department of Metallurgy, Cambridge University. He has been invited by the school's director, **Prof. Julio Cariola,** to lecture on the corrosion of metals. Dr. Hoar's visit to Chile will last from August 19 to September 22.

It has been announced by the Brockhouse Organization that **Mr. A. B. Gowan,** area sales manager (Steel Group) for the North-East and Scottish areas, has retired. Mr. Gowan, who will continue to be available in a consultative capacity, is succeeded by **Mr. R. Newbiggin.**

Formerly of Drummond Asquith, **Mr. C. Pendry** has been appointed sales manager of the newly-formed "Weldall - Grigg Machine Tools" organization, with **Mr. R. A. Hammond,** of Charles S. W. Grigg Limited, as assistant sales manager.

Manager of the machine tool section of the machinery department of Thos. W. Ward Limited, **Mr. Archie Pressley** has retired after 51 years' service with the company. At a special lunch to mark his retirement, **Mr. Harold Vernon,** a director of the company, presented an inscribed silver salver to Mr. Pressley on behalf of his senior staff colleagues.

An announcement from Servomex Controls Limited states that **Mr. Charles Harman** has been appointed as their engineering representative in North-West England.

The retirement from his executive duties is announced of **Mr. J. H. Maxwell,** director and general manager of W. T. Glover and Company Limited, a member of the BICC group, after 51 years' service.

Another retirement is that of **Mr. A. B. Price,** B.Sc., A.M.I.Mech.E., sales manager of The General Electric Company's works at Erith. He has been with the company for 48 years, and on the occasion of his retirement was presented with a cheque on behalf of the company by **Dr. K. J. Wootton,** the general manager of the works, while his friends and colleagues presented Mr. Price with a walnut cocktail cabinet.

Appointments made by Edwin Danks and Company (Oldbury) Limited have been announced as follows: **Mr. A. D. Thompson** has been appointed to the board and becomes deputy managing director. **Mr. C. H. G. Hayward** and **Mr. H. Harding Smith** have been appointed directors of the company.

Appointed sales manager, marine department of Associated Electrical Industries Telecommunications Division of AEI, **Mr. M. T. Marwood,** D.S.C., is succeeding **Mr. W. E. Warren,** who is remaining with the department in a consultative capacity until the end of November.

After over 42 years' service with The General Electric Company Limited, **Mr. J. F. Prince,** M.I.Ex., has now retired. From 1930 he has been manager of the export sales department at the Witton works. He is succeeded by **Mr. K. D. Starr,** B.Sc., A.M.I.E.E., A.M.I.Mech.E., who joined the company in 1947.

It is announced that **Mr. D. B. Flook,** who has lately been with Thos. Ward Limited, has joined Webb Conveyors and Automation Limited, a member of the Elliott-Automation group, as principal sales engineer for the South of England.

RAPID, CONTROLLED AND ECONOMICAL SYSTEM FOR HOT DIP GALVANIZING

Bath Heating

SUITABLE for oil-, gas- or electric-heating, the "Instantheat" system for heating galvanizing baths incorporates features which make it of particular interest. The system, which was described in METAL INDUSTRY, 10 March 1961, pp. 185-6, owes its success to several factors. Of its many practical advantages, a number are attributable to the virtual absence of stored heat in the setting, e.g.:—

When heat is required to bring up the metal temperature, this heat is instantly applied where it is needed, i.e. to the kettle sides: hence temperature pick-up, even during the heaviest use of the bath, is very rapid indeed.

Full production can be resumed immediately after a shut-down period.

The danger of temperature overshoot is entirely eliminated, and there is no risk of damage to the kettle from this source: extremely fine temperature control is available from cold up to normal operating temperature. Thus, melting down (except in the case of the initial lighting-up after installation of the setting, when the temperature has to be raised slowly to avoid any risk of damage arising from a too rapid drying out of the moisture in the setting) can be carried out in a matter of hours.

Other advantages are attributable to the fact that the gases impinge on the kettle side normal to its surface and are not circulated parallel to it, e.g.:—

"Boundary-layer" effect is eliminated, thereby giving improved heat-transfer efficiency.

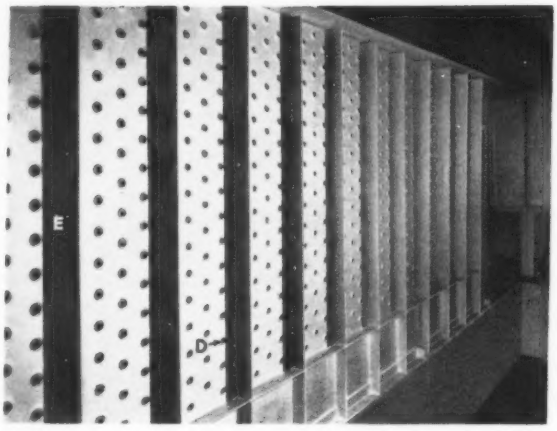
As each square foot of kettle wall area is automatically presented with a predetermined amount of heat in unit time, and this amount is constant throughout, it follows that the metal temperature is kept absolutely uniform and there is no danger of "hot spots", thus contributing to longer bath life, low dross formation and improved economy.

These are some of the main advantages of the system, but the list of examples is not exhaustive and there are others:

The system has an indefinite life as there is nothing to wear out, and there is no danger of deterioration of the ductwork.

When necessary, change of kettle is simplified by the fact that there are no protuberances in the setting to complicate removal of the kettle, and it is unnecessary (provided the kettle has flush sides) to remove the ductwork first. Also, no brickwork is required round the bath sides.

The system is so designed that all parts of the setting to which access is necessary for maintenance purposes (i.e. the fans, fan motors and burners—or electric elements in the case of electric heating) are both easily accessible themselves and yet so positioned (beneath floor level) that they do not in any way interfere with bath access.



Close-up of vertical feed ducts showing nozzles (D) and vertical feed ducts (E) between adjacent ducts

The system also lends itself to adaptation for heating requirements similar to those of kettle heating—e.g. for salt baths as used in the aluminium industries and hemispherical pots as used in the chemical industry (up to a maximum temperature of 600° C.).

Explosive Forming By Electrical Discharge

IN order to develop low-cost shaping of difficult metals like titanium, stainless steel and tungsten, a type of explosive forming, which uses an electrical discharge instead of conventional explosives, has been developed by General Electric Co., Schenectady, New York. Apart from economic forming, electro-spark forming eliminates storage and handling problems associated with chemical explosives and makes isolation of metal-forming facilities unnecessary.

Under development at the company's General Engineering Laboratory, the process is described as "capacitor discharge electro-spark forming". The explosions are induced entirely through a build-up of electrical energy—about 35,000 V at present, but this may eventually go to 100,000 V or more.

Metal forming is done under water, which is used as an efficient medium for shock transmission. The electrical blasts create intense shock waves which are directed against the metal pieces to be formed. Upon impact, the metal takes the shape and surface texture of the die into which it is blown.

The die is evacuated to remove air pockets that could cause irregularities. Forming is done at room temperature, and no preheating of the metal is needed to make it ductile; the formed pieces require relatively little finish machining after removal.

Titanium and niobium have already been successfully shaped, as well as beryllium-copper and the more difficult grades of stainless steel. It is believed that the electro-spark technique can also be used with tungsten and molybdenum, but these metals, which are exceptionally hard to form, have yet to be tested.

Pieces up to 10 in. in diameter and ½ in. thick have been formed by the new process. The forming of much larger pieces is considered feasible; electro-spark forming of sections 10 ft. or more in diameter and at least 1 in. thick is contemplated.

Obituary

Mr. L. H. Cryer

WE regret to record the death of Mr. Leonard H. Cryer, secretary of the National Federation of Scrap Iron, Steel and Metal Merchants for the past four years. He was well-known in the scrap metal trade, having been in the Ministry of Supply for many years.

Dr. A. G. C. Gwyer

IT is with deep regret that we also record the death of Dr. A. G. C. Gwyer, who retired in 1945 after 33 years' service with the British Aluminium Co. Ltd. Having obtained his B.Sc.(Lond.), Dr. Gwyer took his Ph.D. at Göttingen, eventually becoming scientific manager of British Aluminium. He was one of the original members of the Institute of Metals when it was formed in 1908.

Industrial News *Home and Overseas*

Die-casting Machine

Interesting news reaches us from **Alexander Cardew Limited** regarding the Triulzi 2,200 die-casting machine. It is understood that the trials of this machine are to take place at the Triulzi works in Milan from July 17 to 22 next, and that the machine will be working day and night.

Scientific Instruments in Poland

Visiting Catowice, in Upper Silesia, recently, Mr. Hamill, of **Hilger and Watts Ltd.**, was present at an interesting lecture on automatic spectrographs to over sixty representatives of the metals industry which was given by Herr Dipl. Ing. Herbert Eischer. After the lecture, Mr. Hamill was kept busy answering numerous questions from those attending the lecture. A large automatic Hilger spectrograph is already installed and giving very good results in Warsaw.

In the same period, two demonstrations were arranged for metallurgists in Catowice and in Warsaw. These showed the Hilger atomic-absorption equipment, used with the Uvispek spectrophotometer for the analysis of metals in solution.

For Research Workers

A new division of **L. Light and Co. Ltd.** has been established at Colnbrook, Bucks., to provide ultra-pure elements, single crystals and compounds for solid-state physics and metallurgical research. A 10-page catalogue is now available, listing over 250 materials which are prepared in modern laboratories using zone-refining and other techniques.

Notable among these are 99·999 per cent pure phosphorus and boron. Single crystals of indium arsenide, with mobilities in excess of 20,000, are being grown by the Czochralski process.

New Bursary

It has been announced by the Council of the **Institution of Production Engineers** that the Schofield Travel Scholarship is to be replaced by a Bursary of £600 per annum, tenable at a U.K. university for postgraduate studies in production engineering. The figure given includes fees and the Bursary will be tenable for the first time for September-October 1962 entrants.

It is required that applicants must: (a) hold a first degree in engineering or a diploma in technology (Eng.), (b) have fully discussed his proposed course or work with the university of his choice, and (c) have been accepted by the university.

Fuel Firing Equipment

In response to a demand, the **National Industrial Fuel Efficiency Service** is repeating the course on the latest developments in solid fuel firing equipment which was held recently at Manchester.

The new courses will commence at 2 p.m. on Mondays, October 2 and December 4 this year, and February 5 and April 2, 1962, finishing on the following Fridays. The fee for each course is 12 guineas (excluding hotel accommodation).

The course includes a comprehensive introduction to the latest combustion equipment and automatic controls that are now available to industrial and commercial users of solid fuel. Visits to several industrial plants where new equipment has been installed recently and is in operation will be made during the course. It will also include sessions on the maintenance of boilers, mechanical stokers and firing equipment, and the choice of suitable fuels.

Universal Beam Mill

News from Appleby-Frodingham Steel Company, at Scunthorpe, is that they have now put into production their new universal beam mill, engineered by **Schloemann Aktiengesellschaft,** of Düsseldorf. This mill comprises a universal roughing stand with edger, a finishing stand, roller tables, cross transfers and saw. A number of advanced features have been incorporated: most controls are automatic; means for quick roll changing have been provided; all rolls are mounted in roller bearings. The mill is capable of rolling universal wide flange beams with parallel flanges up to 24 in. by 9 in., universal columns up to 12 in. by 12 in. and corresponding junior beams.

Welding News

A new range of A.C. welding equipments, some with a unique remote control system for changing the amperage, is now made available to the welding industry by **Interlas Limited.** There are 200, 300, 400, 500 and 600 amp. models in the range, all robustly built, with infinitely adjustable current ranges and complete with rubber-tyred wheels and pull-out handles for mobility. Triple operator sets are also available.

The 400, 500 and 600 amp. models can be provided with push-button motor-operated amperage control, enabling the welding sets to be mounted on the wall, if desired, to conserve floor space and avoid accidental damage.

Mounted Air Compressor

A mounted air compressor, entirely mobile and self-propelled but at the same time small, compact and robust, has been introduced by **The Lead Wool Company Ltd.** This unit is motivated by a Ford 592E diesel engine, which is of the four cylinder, overhead valve type and drives the compressor through a centrifugal clutch.

The compressor unit is the company's type ACEF, which has a piston displacement of 147 ft^3/min. and delivers approximately 120 ft^3 of free air per min. at 1,350 r.p.m. It is stated that the output of this unit is more than adequate to drive two heavy concrete breakers. It is fitted with an independent air receiver having a capacity of 6·2 ft^3 and a fuel tank holding 12·5 gallons.

The whole unit can, if required, be lifted from the chassis on the removal of six bolts, and a steel truck body (supplied as an extra) fitted, so that the truck can be used during overhaul of the compressor and engine.

Non-Ferrous Metals in Bulgaria

According to a Bulgarian news agency in Sofia, new deposits of non-ferrous ores have been found in the country. The agency claimed that Bulgaria now ranks third in Europe as regards lead deposits and has 40 per cent of the lead and zinc deposits of the Soviet Bloc countries.

In 1958, some 2,414,000 tons of lead and zinc ores and more than 1,000,000 tons of copper ores were produced, B.T.A. said. In 1965, lead and zinc ore production is expected to reach 4,500,000 tons, and copper ore production 6,000,000 tons. In addition to lead, zinc and copper, Bulgaria is now also producing cobalt, cadmium, gold, silver, molybdenum, bismuth and tellurium, and the production of other non-ferrous metals will start in the near future, the agency said.

Malayan Tin Output

An announcement from the Federal Government states that Malaya produced 105,456 piculs of tin-concentrates in May containing 4,745 tons of tin metal based on the true assay of 75·59 per cent. This compared with an April output of 98,719 piculs containing 4,436 tons of tin metal based on the true assay of 75·5 per cent.

At the end of May there were 69 dredges, 506 gravel pump mines and 51 other tin mines in operation, making a total of 626 active tin mines, compared with 72 dredges, 486 gravel pumps and 51 others, making a total of 609 at the end of April.

A New Edition

Just published by the **Aluminium Development Association** is a new edition of its Directory of Members with an index of products. This publication is now divided into two parts, the first being an index of products whereby a user of aluminium requiring it in a particular form—castings, sheet, foil, sections, wire—is given on sight the names of member companies supplying aluminium in that form, and is referred by page number to the second part of the book, in which the full particulars of member companies are set out.

Copies of the directory and index are available without charge to bona fide enquirers.

Spanish Lead Tax

At a Council of Ministers' meeting in Madrid last Friday it was decided that the suspension of the foundry and sales taxes on lead which had been decreed on a temporary basis for the first half of this year should be extended for the next six months. Meanwhile, the Spanish Ministry of Commerce announces that the export of 908 tons of lead ingots to Brazil and 200 tons to Portugal was authorized this week.

News from Birmingham

Little change has taken place in the industrial situation. Production is steady in the non-ferrous mills and foundries, and substantial progress has been made over the first half of the year. During that time unemployment in the Midland area has dropped, largely because of the return to prosperity of the motor trade and the light engineering industries. Makers of machine tools have refilled their order books. The building trade has been enjoying boom conditions, and the outlook in this direction is bright over the second half. With the approach of

the annual holidays, now only a few weeks ahead, the trend of trade is unlikely to show any marked movement, provided that output is not interrupted by labour disputes.

In the iron and steel industry output is maintained, but orders are being executed quicker than they can be replaced. Pressure for supplies of structural steel reflect the marked activity in the building of new office blocks and stores in local cities and towns. Deliveries of sheet are maintained to the motor trade. Re-rollers have sufficient orders for bars and sections to provide regular employment, although more orders could be handled without difficulty. Most of the iron foundries are well situated for work. Great activity continues in the market for heavy castings.

Aluminium Aerial

An aerial recently supplied by J-Beam Aerials Ltd. for a high-powered radio transmitter operating at about 16 mc/sec. was constructed in a novel manner from aluminium tubes to specification BA25WP supplied by **The British Aluminium Company Limited.** The aerial consists of three elements. These are supported centrally in a sand-cast aluminium clamp fixed to a central boom made of aluminium tube 3 in. O.D., 10 gauge wall, also in BA25WP.

The overall length of each element is 30 ft., the 15 ft. overhang of which on each side of the boom consists of a continuous length of tube of step-like form, with three steps each 5 ft. long, the respective outer diameters of each step being 1·5 in., 1·125 in. and 0·75 in. This method of construction was found eminently suitable for minimizing sag, the deflection at each end of the element supported on the tower for test purposes being 1½ in. Previous experience had shown that where single tube of reasonable diameter was used there was considerable sag at the ends of the elements. A second advantage of progressive reduction in the diameter of the element towards each end was a considerable reduction in windage.

Our illustration shows the centre portion of the boom after fixing in its final position, together with the sand-cast aluminium clamp holding each half of the centre element.

Loan for Indian Factory

It is reported that the Commonwealth Development Finance Company Limited has agreed to provide a loan of £175,000 for the manufacture of non-ferrous tubes, pipes, rods and sections in India. The loan will provide the foreign exchange requirement of the factory being erected in Bombay by Kamani Tubes Private Ltd. in collaboration with Yorkshire Imperial Metals Ltd. (an associate of Imperial Chemical Industries Ltd.), who have arranged the procurement of a plant in the United Kingdom and will assist in the running-in period under a 10-year technical collaboration agreement.

As a result of successive five-year plans there is a growing demand in India for non-ferrous products for all types of industries. The indigenous production of non-ferrous components, which at present have to be imported, will provide a more rapid and reliable supply for these industries and will save India foreign exchange estimated at 3 million rupees a year.

Kamani Tubes Private Ltd. is part of the Kamani group of companies, whose ownership and senior management is entirely Indian. The group's other activites include the refining, casting and rolling of non-ferrous metals and alloys in the form of sheets, strips and coils, the production of arsenical copper, zinc oxide, red lead and litharge, and complete manufacture of transmission line towers, cadmium copper conductors, road rollers and electric house meters.

New Furnaces

We are informed by **Blackwell's Metallurgical Works Ltd.,** of Liverpool, that they are installing two new large Monometer rotary furnaces in their Speke Road works to meet the increasing demands for their master alloys. These furnaces are an addition to the two Monometer rotary furnaces which recently went into production at the Banks Road works. The new furnaces at Speke Road works will release many of the larger Morgan crucible furnaces situated at the Church Road works for the manufacture of certain special types of alloys which are becoming more and more in demand.

The rotary melting furnaces are coupled up with automatic ingot casting conveyors. Production at all three works is under one central laboratory control. Blackwell's, which was established in 1869, was one of the first metallurgical firms to produce master alloys for the ferrous and non-ferrous industries for this country and the world. The firm was also a very prominent pioneer in electric arc welding. It supplied powders and alloys for metallic arc welding electrode coatings to the earliest makers of electrodes.

Hydraulic Presses

As from July 1 last, the newly-formed **"Weldall-Grigg Machine Tools"** organization will be responsible for the sales of Weldall-Grigg mechanical and hydraulic presses, "Eldair" press brakes and plate shears, and Weldall-Fired equipment.

The central sales office will be situated in Stour Street, Birmingham, and the London office at 65-67 Hanworth Road, Hounslow, Middx.

Elapsed Time Meter

A new elapsed time meter for recording the time a piece of equipment has been in use is being produced by **The English Electric Company Ltd.** It can be applied to any equipment used intermittently, it is said, and on which planned maintenance or a time log is required, e.g. pumps, ventilating and heating systems, valuable vacuum valves, etc.

The meter is normally connected so that it is automatically switched on and off with the apparatus being metered. The makers state it can register up to 9999.9 hr. in steps of 0·1 hr. The meter is available in two case types.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 315 tons to 7,020 tons, comprising London 3,550, Liverpool 2,356, and Hull 1,114.

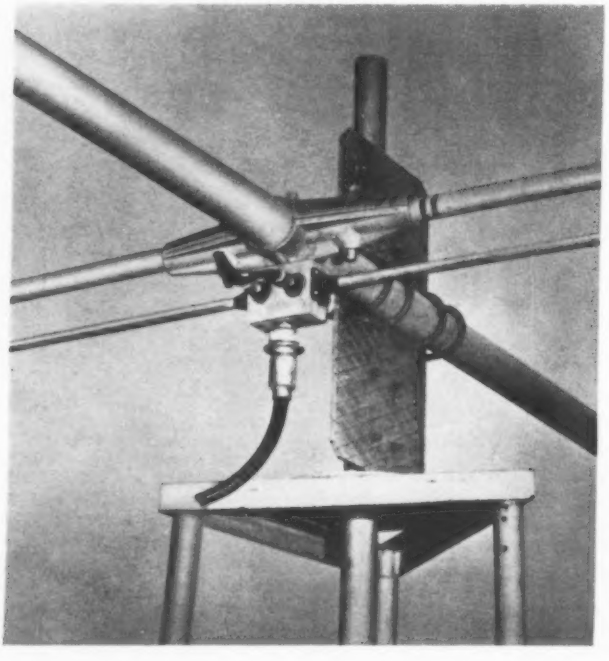
Copper stocks rose 1,275 tons to 19,327, distributed as follows: London 600, Liverpool 15,627, Birmingham 50, Manchester 3,025, and Hull 25.

Lead duty-free stocks fell 75 tons to 7,725 tons, comprising London 7,396, Glasgow 4, and Swansea 325. In-bond stocks were unchanged at 3,743 (all in London).

Zinc duty-free stocks fell 126 tons to 4,269, comprising London 3,176, Glasgow 80, Manchester 450 and Liverpool 563. In-bond stocks fell 30 tons to 2,623 (all in London).

Russian Contract Secured

For some time past a number of British and Continental engines have been running on a new type of bearing developed by the **Glacier Metal Co. Ltd.,** in association with the Tin Research Institute. Known as reticular-tin aluminium, it combines very high load carrying capacity with moderate cost, and in 1959 two thousand sets of such bearings for tests were ordered by the U.S.S.R. Trade Delegation after a visit to the Glacier plant in London.



Aluminium aerial: Centre portion of boom after fixing in its final position, together with the sand-cast aluminium clamp holding each half of the centre element

This was followed by three journeys to Russia by the chairman and managing director of the British company and by a technical team who were given every facility by the Russian producers to study their engines and the bearing problems associated with them. In consequence, it has now been decided to standardize this material on two differing Soviet heavy truck engines, and also on two private car engines, the design of which is being modified so as to take full advantage of the new material in the development of greater power.

It is planned to make these in Russia on plant designed and built by Glacier in England and shipped out within the next two years. The value of the contract which was signed in June between Glacier and Stankoimport is over £400,000.

Welding News

As from July 1 last, the welding business of **The English Electric Co. Ltd.** is being co-ordinated in a newly-formed welding equipment division which is being set up at the company's Accrington works. The manager of the division will be Mr. R. H. Boughton; the chief engineer will be Mr. F. Mullery, and the sales manager will be Mr. E. H. Ayres.

Turkish Copper

Demand for Turkish copper has risen of late, the Eti Bank, which acts as holding company for the Government-owned sector of the metal and ore mining industry, announces. Substantial orders are likely to be placed by Spain. In the first three months of this year exports of copper totalled 2,888 metric tons of an aggregate f.o.b. value of T£14·6 million, over T£10 million of which was on Spanish account. Other destinations were France and Austria.

A Technical Reference Book

The publication by the British Compressed Air Society, on July 3, 1961, of the fifth edition of the B.C.A.S. Technical Reference Book of Compressed Air Terms and Standards, marks the thirtieth year of this major reference work on British practice in the selection, installation, testing, utilization and maintenance of compressed air equipment.

The range of equipment covered includes compressors, rock drills, pneumatic tools for civil engineering and workshop use, spraying plant, pneumatic control equipment and accessories. Other subjects to which detailed reference is made are terminology and standards.

The fifty special graphs and tables relating to compressed air and gases, rock drills, pneumatic tools, pneumatic control equipment, and to friction losses, will be of great value to the engineer. The new edition contains additional graphs and tables on pneumatic control equipment, friction losses in small bore pipe and hose, and on moisture content of air.

Alcoa in Australia

According to reports from New York, the Aluminum Company of America proposes to establish and operate a $100 million concern in Australia which will include a completely integrated operation from the mining of bauxite to aluminium product fabrication. It is expected that this project will expand Australian primary aluminium reduction capacity from the present 12,000 tons annually to some 68,000 tons.

The general scheme includes bauxite mining facilities located at the high grade deposits near Perth; an alumina refining plant in the same area; construction of an aluminium reduction works near Geelong, and mill and other fabricating facilities in the vicinity of Geelong. There will also be construction of power generating facilities for the operation of both mill and reduction undertakings.

The Soviet Exhibition

This exhibition opens today at Earls Court, London, and will remain open until July 29. It is being held under the joint sponsorship of British Chambers of Commerce and the Chamber of Commerce of the U.S.S.R. The object of this exhibition is to show export and import possibilities in the further expansion of Anglo-Soviet trade.

The exhibition is open daily (except Sundays) from 10 a.m. to 10 p.m. and occupies a total area of some 250,000 ft^2. There are 22 halls of exhibits, and in that devoted to science and oceanology visitors will see diverse apparatus and instruments used by Soviet scientists in their scientific research work. The methods they employ in their work will also be shown on a broad scale.

A New Association

Announcement is made of the establishment of the **European Computer Manufacturers' Association** (ECMA), with headquarters and secretariat in Geneva. Members of the association are companies in Europe which develop, manufacture and market data processing machines designed to process digital data for business, engineering, scientific and other similar purposes.

The object of the association is to further the adoption of data processing standards for the benefit of users, the public and the industry itself. Its primary purpose, in co-operation with national and international standards organizations, is to secure inter-company co-operation throughout the industry which will enable European manufacturers to offer better products and services at less cost. This is to be accomplished through the establishment of systems and equipment compatibility, the development of common systems languages and in other appropriate fields of activity. Standardization in these areas will furnish a basis for passing information from one data processing system to another, for performing similar processes on differing machines, and for reducing the effort needed to prepare programs for the operation of data processing equipment manufactured by members' companies.

Health Physics Exhibition

On Wednesday next, July 12, the **Scientific Instrument Manufacturers' Association of Great Britain** have organized, in association with the Summer School of Health Physics, conducted by Dr. H. D. Evans, B.Sc., Ph.D., A.Inst.P., Health Physicist and Lecturer in Radiation Hazards, Imperial College of Science and Technology, University of London, the Health Physics Exhibition, to be held from 10 a.m. to 5 p.m. in the Concert Hall of the Students' Union, The Imperial College of Science and Technology, Prince Consort Road, London. The instruments and equipment of the exhibition are particularly concerned with ionizing radiations, their effects, measurement and control.

Eighteen firms, fifteen of them S.I.M.A. members, are exhibiting, and much of the equipment will be demonstrated. The firms taking part are: Associated Electrical Industries Ltd., Airmec Ltd., Associated Lead Manufacturers Ltd., Baldwin Industrial Controls, Burndept Ltd., Bendix Ericsson (U.K.) Ltd., British Lead Mills Ltd., Dynatron Radio Ltd., Electronic Instruments Ltd., Elliott Nucleonics Ltd., Ekco Electronics Ltd., E.M.I. Electronics Ltd., Isotope Developments Ltd., Linott Engineering Ltd., Nuclear Enterprises Ltd., Panax Equipment Ltd., Research and Control Instruments Ltd., and Wayne Kerr Laboratories Ltd.

New Balance Case

News from **Griffin and George (Sales) Limited** concerns the Griffin "Modern" Balance Case, which they are now marketing. This balance case is basically a new design and made especially for the range of Griffin balances introduced during 1960, though it may be used to house most other balances.

In place of the traditional wooden structure, there is a pressed aluminium sheet framework which is fabricated in three sections and then mounted on a resin-impregnated wooden base faced with an easily cleaned, attractive, linette-finish plastics surface. There are only two glass panels, one in the front panel and the other at the rear, sealed in. The sliding front window, with its sashcord and counterbalance, has vanished. Instead, across the whole front of the case, there is a rising front panel, which has a friction hold and lifting handle, enabling it to be set firmly at any height without causing vibration. The channel holding the glass edges is airtight, while permitting the smoothest action.

The angle of slope of the front is such that easy access for the manipulation of the riders is possible. This is particularly important for the Griffin "Standard", "Duorider" and "Chaindial" balances.

The case is finished in corrosion-resistant light grey melamine-based stoved enamel which gives the maximum of reflected light to the interior; full vision, once obstructed by wood framing, is given by the large glass panels in their attractive grey plastics channels. A dust-free atmosphere is always maintained when the case is closed. Interior dimensions: 19¼ in. wide, 7½ in. deep and 16¼ in. high (49 cm. by 19 cm. by 43 cm.).

Foundry Arts and Crafts

During the latter part of last month a **Foundry Art and Craft Exhibition** was held in the Great Hall of the University of Birmingham, organized by the Department of Industrial Metallurgy. The exhibition lasted three days, and during that time a lecture on "Foundry Art Casting" was given by Mr. D. B. Ball, and a film show of the "Founding of Metals" given.

A wide range of engineering castings was displayed, representing mainly the craft, skill and engineering ingenuity of foundrymen, and in many instances these were also mixed with art. Patterns, moulding, founding in various alloys, including non-ferrous metals, and different moulding methods were demonstrated.

Summer School

From August 29 to September 1, a Summer School will be held at the College of Aeronautics, Cranfield, organized by the **Institution of Production**

Engineers, the subject being "The Interrelation of Work Study, Ergonomics, Operational Research and Cybernetics and Their Application to Production Engineering".

Lectures will be given in the mornings and on two evenings, and demonstrations will be provided. Accommodation and catering in the halls at Cranfield will be available, and the number of places is limited to 120. The inclusive fee for the school, which will also cover accommodation, meals and gratuities, is 10 guineas.

New Lead and Zinc Mine

For several years in succession, prospecting for lead and zinc has been carried out in the Zletovo mining basin in Macedonia. This work has produced good results. It has been established that there are large deposits of lead and zinc ore in the vicinity of the village of Sasi which can be profitably exploited for more than twenty years. The ore found in these deposits contains a high percentage of metal.

At present, preliminary work for the extraction of the newly discovered ores is in progress, and the new mine will be opened by the end of 1963. Since this mine will be a part of the Zletovo Lead Mines and Refinery, a new and large lead and zinc production centre will be established in Macedonia which, together with the Trepca mines, will become one of the biggest producers of these metals in Europe. Furthermore, an ore flotation plant will be opened in the centre which will produce zinc and lead concentrates.

Tin Shipments

According to news from Brussels, the Symetain Company, one of the biggest tin producers in the former Belgian Congo, has resumed export shipments of tin ore "on a modest scale" via Matadi. Three hundred tons are en route for Antwerp. The company's exports came to a standstill towards the end of last year owing to lack of transport, but production continued at the mine. Consequently, the company has a stockpile of 2,900 tons of tin ore, according to company sources. Tin ore output in 1960 by Symetain was put by a leading company source at 4,227 tons, against 4,129 tons in the previous year.

Nigerian Tin

According to an official report in Lagos, Nigeria has begun to produce refined tin metal in commercial quantities and the April production of 101 tons was the first commercial tin metal production in Nigeria.

Award for "Noral News"

The quarterly magazine of **Alcan Industries Limited** has been awarded a Certificate of Merit "for high quality of content and presentation" in the 1961 National House Journal Competition sponsored by the British Association of Industrial Editors. *Noral News* has received six awards altogether in the past few years, four of them in this annual British competition and two in the contest organized in the U.S.A. by the International Council of Industrial Editors.

Edited by Mr. G. G. Walker, Alcan Industries Publicity Division, Banbury, *Noral News* is produced for the interest of employees in all the company's works and offices. It is also distributed to pensioners.

Company Reports

London Aluminium

Final dividend 10 per cent, making 13 per cent for 1960 (12 per cent). Group trading profit £122,518 (£140,244). Less depreciation, etc., £48,280 (£40,082). Add investment income £21,674 (£13,769). Profit £95,912 (£113,931), before tax £45,484 (£47,783). Net profit £50,428 (£66,148). Tax not required £3,000 (nil). Deduct stamp duty on capital increase £2,150 (nil), pensions reserve £5,000 (same), dividends £33,902 (£31,942). Forward £127,903 (£115,527).

Deritend Stamping

Group net profit, year to February 28, 1961, £284,941 (£291,421), and dividend 1s. 9d. per 10s. share (equivalent 1s. 8½d.). Fixed assets £1,199,013 (£1,145,000), and net current assets £1,585,496 (£1,430,162). Commitments £79,000 (£65,000).

A. E. Griffiths (Smethwick)

Group profit for year to March 31, 1961, is shown at £85,716 (£64,220), net balance £41,821 (£32,929). Dividend increased by 5 per cent to 27½ per cent.

Zinc Alloy Rust-Proofing Co.

Dividend 40 per cent year ended April 30, 1961. Consolidated profits £110,258 (£101,038), before tax £55,764 (£49,157).

Trade-Publications

Gauge and Tool Makers. — The Gauge and Tool Makers' Association, Standbrook House, 2-5 Old Bond Street, London, W.1.

A New edition (the eighth) of this association's Handbook and Buyers' Guide Index has just been published. It covers 96 pages, and in addition to summarizing the aims, objects, and activities of the association, it gives the names, addresses, telephone numbers and other details of the present 386 member-companies, and also includes a comprehensive Buyers' Guide Index. The names and addresses, etc., of the members of the British Power Press Manufacturers' Association are also given in this publication.

Electroplating. — W. Canning and Co. Limited, P.O. Box 288, Great Hampton Street, Birmingham, 18.

A number of news sheets have been issued giving details of recent developments in equipment and materials for the electroplating and polishing industries. Items dealt with include the new "Hybrax" bright nickel barrel plating solution for speedy plating in partially or fully immersed barrels. The "Orcene" range of paint strippers, the improved "Hylite" bright zinc solution giving extra brightness and high current density operation over a wide temperature range, and the increased range of "Nupol" abrasives.

Technical Bulletin.—Engelhard Industries Limited, 52 High Holborn, London, W.C.1.

The latest issue of this bulletin contains an article by P. N. Rylander entitled "Ruthenium in Catalysis", also some recent highlights at the company's United States headquarters and, of course, abstracts of selected U.S. Patents. In addition, there is an article by C. Auchmoody on "Silver—A Material of Construction for Handling Hydrochloric Acid and Ammonium Chloride".

Temperature Controller. — Cambridge Instrument Company Limited, 13 Grosvenor Place, London, S.W.1.

In a new list is described an indicating pneumatic temperature controller designed for controlling the working temperatures of vats, autoclaves, or other similar containers; and the temperatures of refrigerating, air-conditioning, or other similar plants and processes, between −20°C. and +340°C. It is stated that the instrument can be used in almost any industrial process where the flow of heating or cooling medium can be regulated by a diaphragm valve.

New Companies

Pressfab Limited (692519), 3 Frederick Road, Edgbaston, Birmingham, 15. Registered May 12, 1961. To carry on business of manufacturers of and dealers in ferrous and non-ferrous castings, etc. Nominal capital, £1,000 in £1 shares. Directors: John H. W. Bradburn and Wm. G. Richardson.

Bayswater Metal Supply Co. Limited (692687), 77 Wimpole Street, W.1. Registered May 15, 1961. Nominal capital, £1,000 in £1 shares. A. Lishnersky signs as director.

Fisher and Abel Limited (692753), 69 River Road, Barking. Registered May 15, 1961. To carry on business of welders, metal finishers, etc. Nominal capital, £100 in £1 shares. Directors: Thomas M. Fisher, Roy F. Abel, Emily Fisher and Mrs. Doria E. Abel.

Maywood Metals Limited (693200), 25 Oakfield Road, Ilford. Registered May 18, 1961. Nominal capital, £100 in £1 shares. Directors: James Maywood and Julie R. Maywood.

Metalcraft (Welwyn) Limited (693235), 154 Woodfield Way, N.11. Registered May 19, 1961. To carry on business of metal merchants, etc. Nominal capital, £200 in £1 shares. Directors: Lewis Sugarman, Dennis E. Holder-Vale and Ronald Sibbald.

J. R. Skinner (Haulage) Limited (693555), 12 Mackenzie Road, N.7. Registered May 24, 1961. To take over the business of a scrap iron and metal merchant carried on at Mackenzie Road, N., as "J. R. Skinner" and to carry on business of haulage contractors, etc. Nominal capital, £1,000 in £1 shares. Directors: Joseph R. Skinner and Joseph T. W. Skinner.

Colmore Pressings Limited (693775), 129 Conybere Street, Birmingham, 12. Registered May 29, 1961. To take over the business of Light Engineering and Pressworkers carried on at Birmingham, etc. Nominal capital, £1,000 in £1 shares. Directors: Edward H. Fedeski and Douglas E. Fedeski.

Metal Market News

TIN CONTINUES MOVE UP — COPPER MOVES UP SLOWLY — LEAD AND ZINC STEADY

SENTIMENT on the Metal Exchange last week was rather depressed, affected probably by the collapse in tin values following news that the three weeks' old strike in Bolivia had been settled, and also a suggestion that the U.S. Government would release nearly 4,000 tons of tin ex the former National Smelter at Texas City. It was, moreover, considered likely that exports would shortly be resumed from the Congo. Examined against the background of the likely shortfall in tin this year, these pointers do not seem of sufficient importance to bring about a setback of the magnitude seen last week, but the fact remains that the quotation fell by nearly £30, closing at the lowest on Friday afternoon. The market is, of course, very unsettled and jumpy so that, in a sense, it can be said that anything can happen. Not surprisingly, Metal Exchange stocks of tin in official warehouses declined by 755 tons to 7,335 tons, the lowest level touched since November 1959. Doubtless, when this week's figures are made available, a further decline will be registered. The downturn in the price began on Monday of last week, when it was reported that the United States steel industry had begun a drive to get tin released from the Government stockpile. Stocks of copper in Metal Exchange warehouses increased by 625 tons to 18,052 tons and further additions are confidently expected. Reserves of lead fell by 300 tons to 11,543 tons, while zinc stocks were 145 tons down at 7,048 tons.

By and large, trading was very much quieter last week than in the preceding period, the turnover in copper being only about one-half what it was and in tin approximately one-third. On the other hand, the amount of zinc changing hands doubled, as well it might, for the previous turnover was very poor. There appears to have been a falling off in consumer demand for all the metals and, not unnaturally, this was reflected in the degree of activity in Whittington Avenue. For example, some 10,600 tons of copper changed hands on a fluctuating market which left the cash price finally £2 lower on balance at £233 5s. 0d. In three months, the loss was no more than 25s., and the contango increased to £4 on the week. The forward quotation on Friday afternoon stood at £237 5s. 0d. Since stocks of copper in warehouse are expected to continue to build up, nothing would be less surprising than that the premium for three months over cash should increase. Since a £4 contango offers every inducement to hedging and consumer business is reported to be slow, it seems reasonable to expect a fair amount of forward selling by industry.

The close in copper was no more than 10s. above the lowest, and the outlook for a recovery is not very promising just now. In the absence of strikes, and with the holiday period ahead, it would certainly seem as though the cash price could drop back to the neighbourhood of £225. The turnover in tin was about 3,620 tons, and the quotations stood at their lowest when business ended on Friday afternoon. Cash had then suffered a loss of £27 10s. 0d. at £912, and three months was £26 down at £917. A pretty severe shakeout, it must be admitted. Lead and zinc were rather featureless, and there were no startling developments. On a turnover of 9,300 tons, lead closed virtually unchanged at £65 5s. 0d. cash and £66 7s. 6d. three months. Zinc, on a turnover of 7,625 tons, gained 15s. for cash at £78 15s. 0d. and 17s. 6d. three months at £79 17s. 6d. The price of nickel in the U.K. was raised last Friday by £60 to £660.

New York

Copper futures have been easier this week on active liquidation following the labour settlements at Kennecott's western division and the American Metal Climax Carteret plant with the International Mine Mill Workers Union. The undertone in physical copper was softer. Some copper sources believe that the downward pressure on the custom smelter price will now increase although custom smelters are well sold up throughout July.

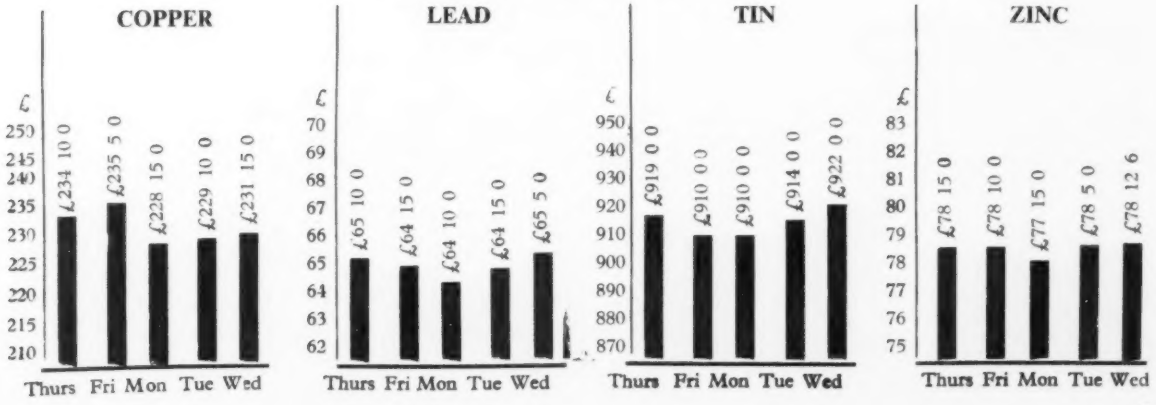
The Cerro Corporation disclosed that it has obtained an option on a possible site for a primary aluminium smelter on the lower Colombia River. Under an agreement signed with the Wauna Lumber Company — owner of the property—Cerro took an option on 1,030 acres of land with deep water dock facilities at Wauna, Oregon, 42 miles upstream from the Colombia River's mouth. Cerro had previously announced that it is actively investigating the possibility of erecting a primary aluminium reduction plant with an annual capacity of approximately 55,000 tons to be served from the Bonneville power administration.

Zurich

A revival of business was noted on the Swiss non-ferrous metals market during June, due partly, according to trade quarters, to major contracts for users' requirements in the autumn. The main feature was rising demand for copper and tin since, in view of the diminishing supplies of spot goods, manufacturers wanted to make sure of sufficient stocks. Buying interest in zinc was stimulated by lower prices and trading in aluminium was active. But trade circles believe that, barring unexpected development, turnover will decline in July.

London Metal Exchange

Thursday 29 June to Wednesday 5 July 1961



C

NON-FERROUS

PRIMARY METALS

All prices quoted are those available at 2 p.m. 5/7/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	237	10	0
Antimony Metal 99%	„	230	0	0
Antimony Oxide Commercial	„	194	10	0
Antimony White Oxide	„	212	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	0
Calcium	„	2	0	0
Cerium 99%	„	15	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite per unit			8	10	0
Copper H.C. Electro	ton	231	10	0
Fire Refined 99·70%	„	230	0	0
Fire Refined 99·50%	„	229	0	0

		£	s.	d.
Copper Sulphate	ton	79	10	0
Germanium	grm.		—	
Gold	oz.	12	11	7½
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	65	5	0
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		5	6
Alloy Ingot, AZ91X	„	1	11¼-2	1¼
Manganese Metal	ton	280	0	0
Mercury	flask	66	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	660	0	0
F. Shot	lb.		—	
F. Ingot	„		—	
Osmium	oz.	20	0	0
Osmiridium	„		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	123	0	0
Silver Spot Bars	oz.		6	7⅛
Tellurium Sticks	lb.	2	0	0
Tin	ton	922	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	79	2	6
Dust 95/97%	„	125	0	0
Dust 98/99%	„	131	0	0
Granulated 99+%	„	104	2	6
Granulated 99·99+%	„	116	11	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

All prices quoted are those available at 2 p.m. 5/7/61

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5 ton	210	0	0
B.S. 1490 L.M.6 „	202	0	0
B.S. 1490 L.M.7 „	216	0	0
B.S. 1490 L.M.8 „	203	0	0
B.S. 1490 L.M.9 „	203	0	0
B.S. 1490 L.M.10 „	221	0	0
B.S. 1490 L.M.11 „	215	0	0
B.S. 1490 L.M.12 „	223	0	0
B.S. 1490 L.M.13 „	216	0	0
B.S. 1490 L.M.14 „	224	0	0
B.S. 1490 L.M.15 „	210	0	0
B.S. 1490 L.M.16 „	206	0	0
B.S. 1490 L.M.18 „	203	0	0
B.S. 1490 L.M.22 „	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 ton	155	0	0
B.S. 1490 L.M.2 „	157	0	0
B.S. 1490 L.M.4 „	164	0	0
B.S. 1490 L.M.6 „	176	0	0
***Aluminium Bronze**			
BSS 1400 AB.1 ton	246	0	0
BSS 1400 AB.2 „	254	0	0

		£	s.	d.
***Brass**				
BSS 1400-B3 65/35	ton	176	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	223	0	0
***Gunmetal**				
R.C.H. 3/4%	ton		—	
(85/5/5/5) LG2	„	214	0	0
(86/7/5/2) LG3	„	229	0	0
(88/10/2/1)	„	288	0	0
(88/10/2½)	„	298	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	195	0	0
BSS 1400 HTB2	„	215	0	0
BSS 1400 HTB3	„	231	0	0
Nickel Silver				
Casting Quality 12%	„	260	0	0
„ „ 16%	„	270	0	0
„ „ 18%	„	310	0	0
***Phosphor Bronze**				
B.S.1400P.B.1.(A.I.D. released)	„	315	0	0
B.S. 1400 L.P.B.1	„	243	0	0

**Average prices for the last week-end.*

Phosphor Copper	£	s.	d.
10% ton	264	0	0
15% „	267	0	0
Phosphor Tin			
5% „	1,011	0	0
Silicon Bronze			
BSS 1400-SB1 „	290	0	0
Solder, soft, BSS 219			
Grade C Tinmans „	411	5	0
Grade D Plumbers „	326	10	0
Grade M „	453	10	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „ „		—	
Zinc Alloys			
BSS 1004 Alloy A ton	110	1	3
BSS 1004 Alloy B „	114	1	3
Sodium-Zinc lb.		2	6½

SCRAP METALS

Merchants' average buying prices delivered, per ton, 4/7/61

Aluminium	£
New Cuttings	139
Old Rolled	104
Segregated Turnings	79
Brass	
Cuttings	162
Rod Ends	144
Heavy Yellow	137
Light	132
Rolled	147
Collected Scrap	133
Turnings	138

Copper	£
Wire	206
Firebox, cut up	204
Heavy	203
Light	200
Cuttings	211
Turnings	186
Braziery	168
Gunmetal	
Gear Wheels	198
Admiralty	198
Commercial	183
Turnings	178

Lead	£
Scrap	55
Nickel	
Cuttings	—
Anodes	554
Phosphor Bronze	
Scrap	183
Turnings	178
Zinc	
Remelted	70
Cuttings	64
Old Zinc	44

METAL PRICES

SEMI-FABRICATED PRODUCTS

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products

	£ s. d.
Aluminium	
Sheet 10 S.W.G. lb.	2 10½
Sheet 18 S.W.G. „	3 0½
Sheet 24 S.W.G. „	3 3½
Strip 10 S.W.G. „	2 10½
Strip 18 S.W.G. „	2 11½
Strip 24 S.W.G. „	3 1
Circles 22 S.W.G. „	3 4½
Circles 18 S.W.G. „	3 3½
Circles 12 S.W.G. „	3 2½
Plate as rolled „	2 10
Sections „	3 4
Wire 10 S.W.G. „	3 1½
Tubes 1 in. o.d. 16 S.W.G. „	4 4
Aluminium Alloys	
BS 1470. HS19W.	
Sheet 10 S.W.G. „	3 3
Sheet 18 S.W.G. „	3 5½
Sheet 24 S.W.G. „	4 1
Strip 10 S.W.G. „	3 3
Strip 18 S.W.G. „	3 4½
Strip 24 S.W.G. „	4 0½
BS1477. HP30M. Plate as rolled „	3 1
BS1470. HC15WP.	
Sheet 10 S.W.G. „	4 3
Sheet 18 S.W.G. „	4 8½
Sheet 24 S.W.G. „	5 8½
Strip 10 S.W.G. „	4 4
Strip 18 S.W.G. „	4 8½
Strip 24 S.W.G. „	5 4½

	£ s. d.
Aluminium Alloys—cont.	
BS1477. HPC15WP. Plate heat treated .... lb.	3 10½
BS1475. HG19W. Wire 10 S.W.G. „	4 2
BS1471. HT19WP. Tubes 1 in. o.d. 16 S.W.G. „	5 5
BS1476. HE19WP. Sections „	3 4
Split tube	
19 S.W.G. (⅛″) „	4 2
20 S.W.G. (⅜″) „	3 11
21 S.W.G. (⅜″) „	4 1
22 S.W.G. (¼″) „	4 11
Welded tube 14 to 20 S.W.G. (sizes ½″ to 1½″) „	3/10½ to 5/8½
Brass	
Tubes lb.	1 9¾
Brazed Tubes „	3 2¾
Drawn Strip Sections „	3 2¾
Sheet ton	198 15 0
Strip „	198 15 0
Extruded Bar lb.	2 0¾
Condenser Plate (Yellow Metal) ton	192 0 0
Condenser Plate (Naval Brass) „	205 0 0
Wire lb.	2 8½

	£ s. d.
Beryllium Copper	
Strip lb.	1 4 11
Rod „	1 1 6
Wire „	1 4 9
Copper	
Tubes lb.	2 3¾
Sheet ton	264 15 0
Strip „	264 15 0
H.C. Wire „	285 5 0
Cupro Nickel	
Tubes 70/30 lb.	3 7
Lead	
Pipes (London) ton	107 0 0
Sheet (London) „	104 15 0
Tellurium Lead „	£6 extra
Nickel Silver	
Sheet and Strip 10% lb.	3 11
Wire 10% „	4 4
Phosphor Bronze	
Wire „	4 2
Titanium (1,000 lb. lots)	
Billet 4½″ to 18″ dia. lb.	47/- 48/-
Rod ¼″ to 4″ dia. „	85/- 53/-
Wire ·036″-232″ dia. „	159/- 99/-
Strip ·001″ to ·048″ „	350/- 68/-
Sheet 8′ × 2′. 20 gauge „	73/-
Tube, representative average gauge „	198/-
Extrusions „	90/-
Zinc	
Sheet ton	116 5 0
Strip „	nom.

FOREIGN QUOTATIONS

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

Belgium	fr/kg	£/ton
Copper: electrolytic	32.25	235 14
Tin	132.00	1034 15

Canada	c/lb	£/ton
Aluminium	26.00	210 12
Copper: electrolytic	30.00	243 0
Lead	10.50	81 0
Nickel	70.00	567 0
Zinc: Prime western	11.75	95 3
High grade 99.95	12.35	100 0
High grade 99.99	12.75	103 5

France	fr/kg	£/ton
Aluminium	2.43	179 11
Antimony 99·0	2.80	206 18
Cadmium	16.25	1,200 17
Copper: electrolytic	3.26	240 18
Lead	.95	70 4
Nickel	9.00	665 2
Tin	13.36	982 17
Zinc: Thermic	1.16	87 18
Zinc: electrolytic	1.24	91 12
Scrap		
Copper: electrolytic	2.90	214 8
Heavy copper	2.90	214 8
No. 1 copper wire	2.80	206 18
Brass rod ends	2.20	162 11
Zinc castings	.92	67 19
Lead	.92	67 19
Aluminium	1.75	129 6

Italy	lire/kg	£/ton
Aluminium	370	216 1
Antimony 99·0	520	303 13
Copper: wire bars 99.9	455	265 14
Lead	163	96 3
Nickel	1,180	689 2
Tin	1,720	1,004 9
Zinc: electrolytic	181	105 14
Scrap		
Aluminium soft sheet clippings (new)	305	178 2
Lead, soft, first quality	137	80 0
Lead, battery plates	77	45 19
Copper, first grade	380	221 18
Bronze, commercial gunmetal	360	221 4
Brass: heavy	280	163 10
Brass: light	265	155 15
Brass, bar turnings	280	163 10
Old zinc	105	61 6

Switzerland	fr/kg	£/ton
Aluminium	2.50	210 5
Copper: electrolytic	2.96	248 18
Lead	.82	68 19
Nickel	7.50	630 15
Tin	11.25	946 2
Zinc: High grade 99.99	1.06	89 2

Japan Yen per metric ton	
Scrap	
Copper: electrolytic	303,000
Copper wire No. 1	281,000
Copper wire No. 2	268,000
Heavy copper	268,000
Light copper	237,000
Brass, new cuttings	208,000
Red brass scrap	215,000

West Germany *Scrap*	D-marks per 100 kilos	£/ton
Used copper wire	225	204 19
Heavy copper	225	204 19
Light copper	200	182 4
Heavy brass	150	136 13
Light brass	120	109 6
Soft lead	58	52 16
Zinc	57	51 18
Used aluminium unsorted	80	72 17

United States	c/lb	£/ton
Aluminium	26.00	207 4
Antimony 99·0	32.50	259 0
Cadmium	160.00	1,275 4
Copper: electrolytic	31.00	247 10
Lead	11.00	87 13
Nickel	81.25	647 11
Tin	115.87	923 9
Zinc: electrolytic	12.50	99 12

THE STOCK EXCHANGE

Conditions Continued Quiet And Market Lacked Support

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 3 JULY	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation	32/6	—3d.	11	9	6 15 6	33/9	26/3	35/-	26/6
400,000	2/-	Anti-Attrition Metal	1/3		NIL	4	NIL	1/3½	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries	40/-		15	15	7 10 0	54/10½	39/6	67/3	38/3
3,895,963	1	Birfield	62/9		10	15‡	3 3 9	78/9	45/-	51/3	29/-
4,795,000	1	Birmid Industries	87/-	—3/-	20	20D	4 12 0	103/-	71/3	74/9	56/-
8,445,516	Stk. (10/-)	Birmingham Small Arms	25/3	—3d.	17½QT	12½	4 12 6	36/10½	24/4½	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/6		5	5	6 18 0	14/6	13/9	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/-		6	6	7 1 3	17/6	16/4½	20/-	17/1½
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6%	15/9	—6d.	6	6	7 12 6	18/-	15/6	21/1½	17/7½
18,846,647	Stk. (£1)	British Insulated Callender's Cables	58/6	—1/6	13½	13½	4 12 3	62/3	49/-	61/4½	47/-
20,456,599	5/-	British Oxygen Co. Ltd., Ord.	22/-	+6d.	16D	16	2 8 6	28/4½	17/6	35/-	19/10½
1,200,000	Stk. (5/-)	Canning (W.) & Co.	15/6	+3d.	15⅝	25+•2½C‡	5 0 6	20/9	13/7½	19/9	13/7½
60,484	1/-	Carr (Chas.)	1/1½	+1½d.	NIL	12½	—	1/7½	10½d.	2/3	1/-
555,000	1	Clifford (Chas.) Ltd.	30/4½		12	10	7 18 0	30/4½	26/-	35/-	28/9
45,000	1	Ditto Cum. Pref. 6%	15/-xd		6	6	8 0 0	15/3	15/-	16/-	15/10½
300,000	2/-	Coley Metals	3/6xd		15	15	8 11 6	4/5½	3/6	5/-	3/4½
10,185,696	1	Cons. Zinc Corp.†	70/-		20	15	5 14 3	81/6	64/-	80/9	59/6
5,399,056	1	Davy-Ashmore	150/-	—2/-	30‡	20	2 0 0	177/6	129/6	147/3	99/6
8,000,000	5/-	Delta Metal	23/1½		20	17½	4 6 6	27/7½	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	40/6	—9d.	15	15	7 8 3	52/3	40/3	56/9	45/-
1,155,000	1	Evered & Co.	45/9		10B	10φ	2 18 3	45/9	42/6	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	33/6	—9d.	10	10	5 19 6	39/6	29/6	47/9	29/-
1,500,000	Stk. (10/-)	General Refractories Ltd.	60/-		25	20	4 3 3	65/-	42/9	52/6	40/-
937,500	5/-	Glacier Metal Co. Ltd.	18/6		15	13	4 1 0	21/1½	13/9	16/1½	11/1½
2,500,000	5/-	Glynwed Tubes	29/6		22½	25¶	3 16 3	30/3	23/7½	27/6	17/-
7,228,065	10/-	Goodlass Wall & Lead Industries	34/3		15	19L	4 7 6	44/9	33/9	41/9	33/-
696,780	10/-	Greenwood & Batley	23/9	—1/3	15	30‡	6 6 3	29/6	22/6Z	33/6	29/1½
792,000	5/-	Harrison (B'ham) Ord.	12/9	—6d.	•20‡	•17½	3 18 6	14/6	12/-	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	19/9		7	7	7 1 9	20/4½	19/9	23/6	22/-
1,612,750	5/-	Heenan Group	13/9		13	15	4 14 6	17/1½	10/6	13/-	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries	69/6		13½	11½	3 19 0	81/6	63/1½	76/6	54/-
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	14/6	—3d.	5	5	6 18 0	16/-	14/4½	18/-	15/4½
29,196,118	••	International Nickel	143	+5½	$1.60	$1.50	1 16 0	152½	104	105	84½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	14/-		5	5	7 2 9	14/10½	13/6	16/6	14/6
6,000,000	1	Ditto Ord.	73/9		15	12	4 1 6	75/-	59/6	67/6	44/9
600,000	10/-	Keith, Blackman	20/-		17½	17½E	8 15 0	21/6	18/3	32/6	17/6
320,000	4/-	London Aluminium	12/9xd	—6d.	13	12	4 1 6	15/-	8/6	12/6	7/10½
765,012	1	McKechnie Bros. Ord.	61/6	—2/9	17½F	15F	5 13 9	68/-	53/6	71/6	57/3
1,530,024	1	Ditto A. Ord.	61/3		17½F	15F	5 14 3	67/-	53/3	69/3	55/-
1,108,268	5/-	Manganese Bronze & Brass	15/9	—3d.	20⅝	20⅝	6 19 0	18/6	14/-	18/6	13/4½
50,628	6/-	Ditto (7½% N.C. Pref.)	5/6		7½	7½	8 3 6	6/-	5/3	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	84/-	—1/6	12	12M	2 17 3	100/9	68/3	84/3	61/-
415,760	Stk. (2/-)	Metal Traders	7/-		50	50	14 5 9	8/7½	6/9	10/9	7/1½
160,000	1	Mint (The) Birmingham	53/6		15	12½	5 12 3	53/6	36/-	39/-	33/6
80,000	5	Ditto Pref. 8%	76/3		6	6	7 17 6	77/6	76/-	80/-	75/-
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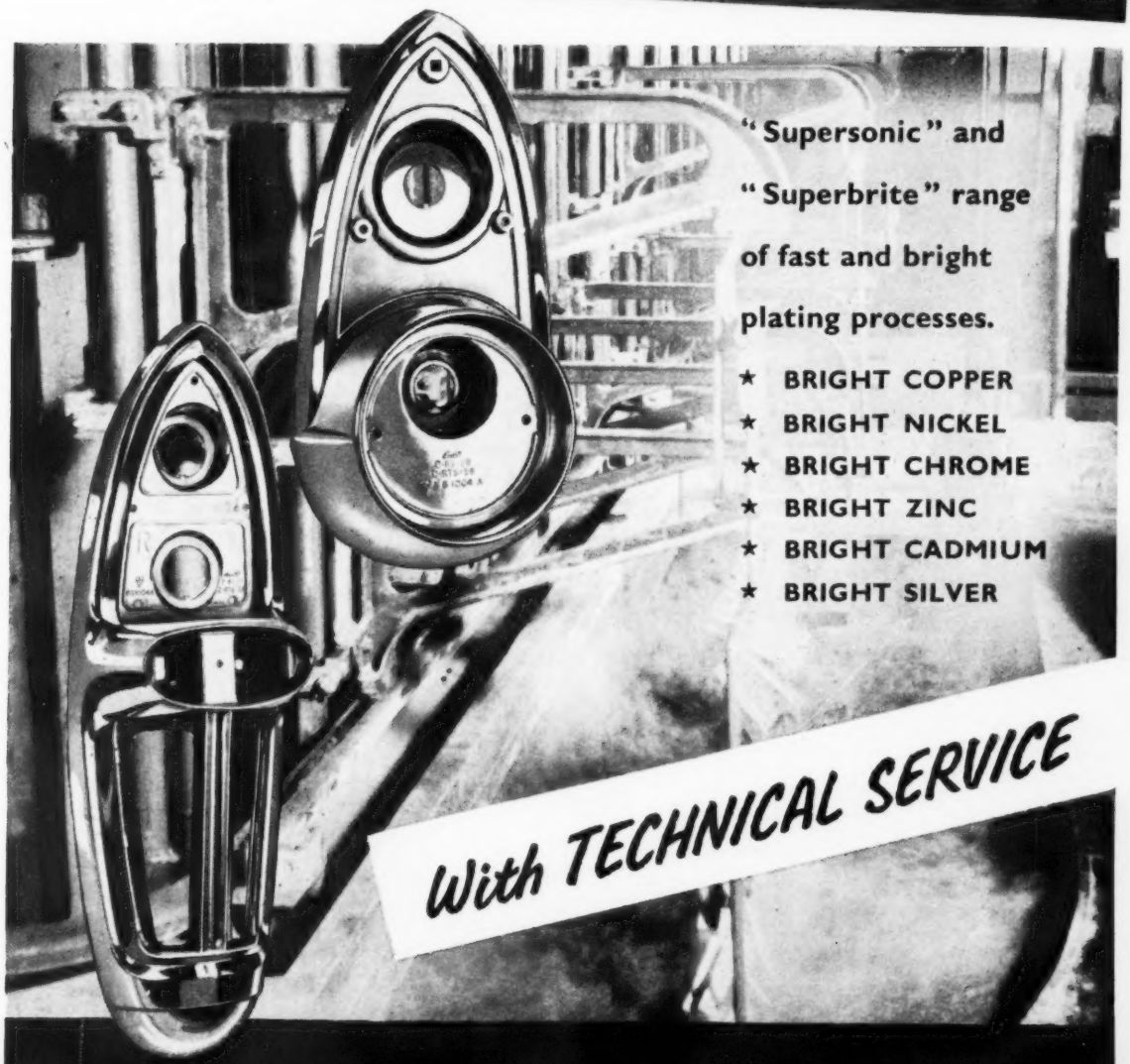

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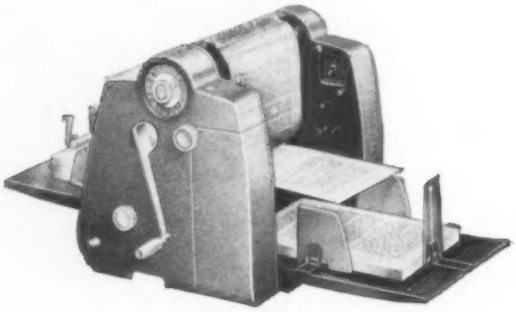

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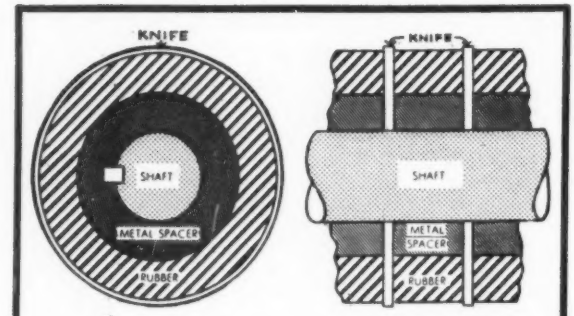

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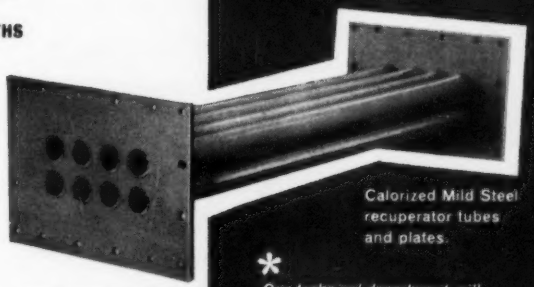

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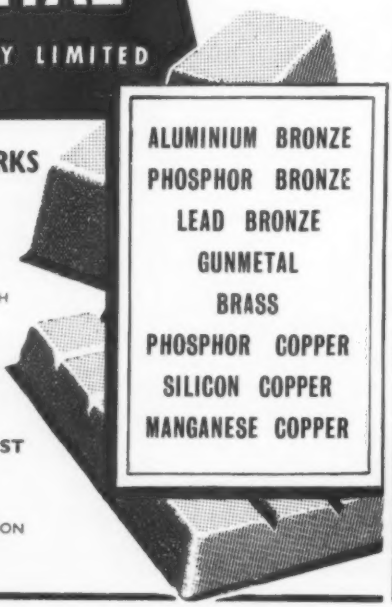

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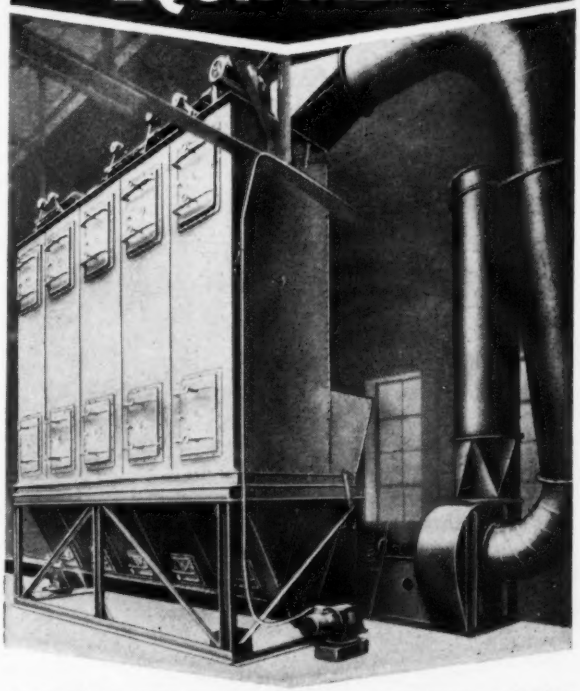

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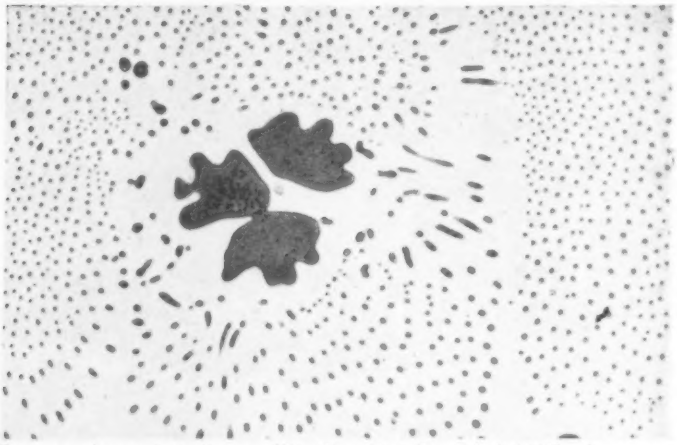

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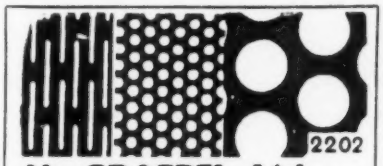

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INDEX TO ADVERTISEMENTS

	Page
AEI-Birlec Ltd.	14
Alreco Metal Corporation Ltd.	*Outside front cover*
Aluminium Bronze Co. Ltd.	*Inside back cover*
Associated Lead Manufacturers Ltd.	*Inside back cover*
Associated Pressings Ltd.	20
Auto Aero Ltd.	18
Barnett Ltd., H.	23
Birwelco Ltd.	21
Bolton & Sons Ltd., Thomas	13
British Furnaces Ltd.	10
Brock Metal Co. Ltd., The	23
Brookes (Oldbury) Ltd.	1
Brooks & Co. (Metals) Ltd., T. J.	22
Brookside Metal Co. Ltd.	24
Calorizing Corporation of Great Britain Ltd.	19
Canning & Co. Ltd., W.	*Inside front cover*
City Casting & Metal Co. Ltd.	24
Consolidated Zinc Corporation (Sales) Ltd.	16
Deutsch & Brenner Ltd.	18
Entores Ltd.	22
Eyre Smelting Co. Ltd., The	21
Firma-Chrome Plating Co. Ltd., The	12
Frost Ltd., N. T.	24
Garnham & Sons Ltd., J. B.	20
Graepel Ltd., H.	23
Great Bridge Foundry Co. Ltd.	19
Harris Plating Works Ltd.	12
Head Wrightson Machine Co. Ltd.	8, 9
Hilger & Watts Ltd.	3
Hooker Ltd., W. J.	18
Ilfar Aluminium Co. Ltd.	12
Incandescent Heat Co. Ltd., The	6
International Refining Co. Ltd.	*Inside back cover*
Joseph & Sons Ltd., M.	22
Levick Ltd., John	23
Lindemann Maschinenfabrik G.m.b.H.	2
McGhee (Metals) Ltd., Hugo	20
Metal Distributors (U.K.) Ltd.	*Inside front cover*
Metallurgical Services	22
Morgan Crucible Co. Ltd.	4
Park & Paterson Ltd.	7
Rapid Magnetic Ltd.	13
Rhondda Metal Co. Ltd.	20
Robertson & Co. Ltd., W. H. A.	5
Silvercrown Ltd.	17
Simpson (Assayer) Ltd., Gordon	12
Sklenar Furnaces Ltd.	*Outside back cover*
Stuart (London) Ltd., Robert	12
Ward Ltd., Thomas W.	11
Wolverhampton Trading & Scrap Co. Ltd	12

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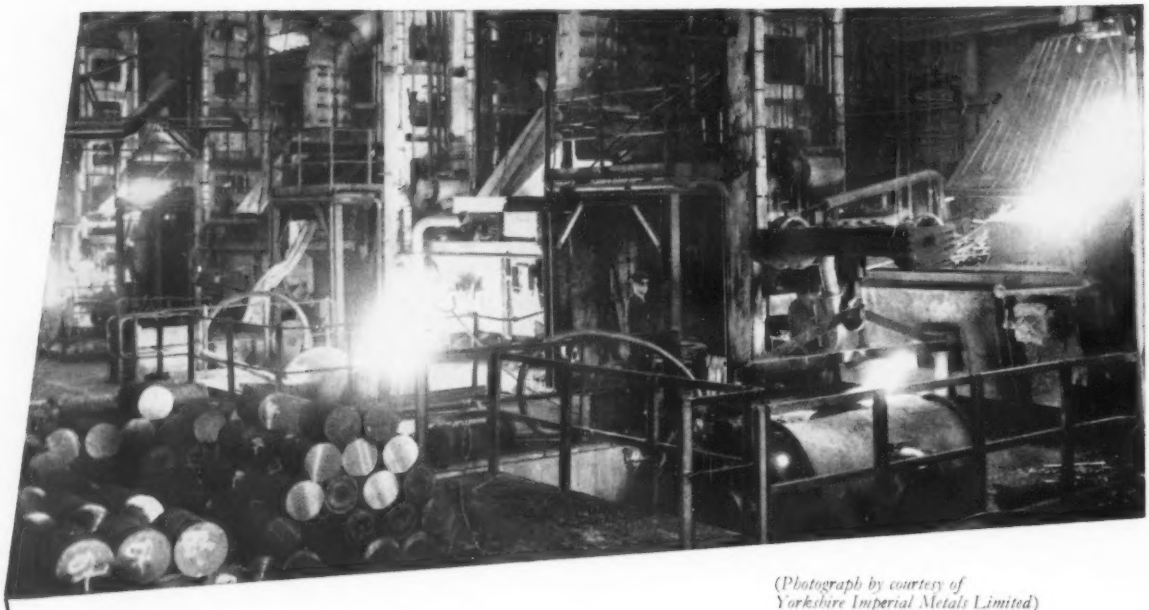

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